BECKMAN

DIGITAL MULTIMETER SERIES 3000 AND SERIES 300

SERVICE MANUAL

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AN IMPORTANT NOTICE

This Service Manual is intended for use by personnel who have had training and are experienced in servicing this type of instrument. Because of the possible hazards to an inexperienced person in servicing this product, as well as risk of damage to the instrument, Beckman Instruments strongly recommends that all servicing be performed by Beckman Service personnel.

In addition, to improve instrument performance, changes may have been made to the instrument after this Service Manual was printed. Accordingly, Beckman Instruments makes no representations or warranties, either express or implied, that the information contained in this Service Manual is complete or accurate. It is understood that the purchaser must assume all risks in the use of this Service Manual for the purposes of performing service upon the instrument it covers.

GENERAL SAFETY PRECAUTIONS

As you read this manual, pay particular attention to safety warnings covering different phases of the equipment you are servicing. Reminders such as WARNING and CAUTION have been incorporated into the various sections; take time to read them carefully. If you prevent just one accident, this is time well spent.

SECTION ONE

GENERAL INFORMATION

INTRODUCTION

The Series 300 and Series 3000 Digital Multimeters are a group of portable 3½ digit multimeters designed for use by the engineer, technician, or hobbyist. Each of the wide variety of functions and ranges available is quickly and easily selected with the turn of a single selector switch. The portability and accuracy of these instruments make them equally well suited for design engineering, production testing, field servicing, and industrial maintenance applications.

MODEL DIFFERENCES

TECH™ 300

This basic multimeter is equipped with six functions and 27 ranges -- each test position selected by turning the Function/Range Switch. It is accurate to ±0.5% of readings in DC volts.

TECH™ 300 and MODEL 3000

These models also have six functions and 27 ranges, but are accurate to ±0.25% of readings in DC volts.

TECH™ 310 and MODEL 3010

These multimeters have seven functions and 29 ranges, and are accurate to ±0.25% of readings in DC volts. One particularly useful feature is the added 10 ampere range for current measurement. These and all subsequent models also feature Insta-Ohms®for quick visual indication of continuity.

TECH™ 310UL and MODEL 3010UL

Like the Tech 310 and Model 3010, these models also feature seven functions and 29 ranges, with accuracy of ±0.25% of DC voltage readings. In addition, these models have wiring and specifications that allow them to be Underwriter Laboratories (UL) listed.

MODEL 3020
This model contains seven functions and 29 ranges, with an accuracy of ±0.1% of readings in DC volts.

TECH™ 320B and MODEL 3020B
These multimeters have the same features and specifications as the Model 3020, and also produce an audible tone to indicate continuity between two points.

TECH™ 330 and MODEL RMS 3030
These models contain the same features as the Model 3020, with the added ability to measure both AC voltage and current in true RMS. The direct-coupled inputs of the meters permit direct measurement of total (AC + DC) RMS value of complex or non-sinusoidal AC waveforms.

TECH™ 350 and MODEL 3050
The first of the Bench/Portable series of meters, these models have seven functions and 30 ranges, and are accurate to ±0.1% of readings in DC volts. Added features include an audible continuity indicator and a 20 ohm resistance range.

TECH™ 360 and MODEL RMS 3060
These multimeters contain the same features as the Tech 350 and Model 3050, plus the capability of measuring AC signals in switch-selectable true RMS (AC only or AC + DC). In addition, they have direct-temperature reading capability via a fully compensated K-type thermocouple. Accuracy is ±4°C on measurements from -20°C to 300°C and ±3% of a reading from +300 to 1265°C (not including thermocouple errors).

MODEL HD 100
This heavy-duty multimeter has seven functions and 27 ranges, and is accurate to ±0.25% of readings in DC volts. In addition, the case of the HD 100 has been manufactured to sustain repeated accidental drops , is completely sealed against contamination from moisture and dirt, and has increased overload protection.

SPECIFICATIONS
HAND HELD METERS

GENERAL

OPERATING TEMPERATURE RANGE
0°C to +50°C

STORAGE TEMPERATURE RANGE
-40°C to +65°C with battery removed.

DISPLAY
3 1/2 digit liquid crystal display (LCD) with a maximum reading of 1999.

POWER
Hand-Held Models: Single, standard 9-volt transistor battery, NEDA 1604.

BATTERY LIFE
Alkaline: 2000 continuous hours, nominal.
Zinc-Carbon: 1600 continuous hours, nominal.
Under typical usage, 2 years.

LOW BATTERY INDICATOR
Decimal point blinks with approximately 10% of battery life remaining.

SHOCK AND VIBRATION
Meets MIL-T-28800 specifications.

RELATIVE HUMIDITY
0% to 80%, 0°C to 35°C
0% to 70%, 35°C to 50°C

TEMPERATURE COEFFICIENT
0°C to 20°C, 30°C to 50°C
Less than 15% of applicable accuracy specifications per °C.

MAXIMUM COMMON-MODE VOLTAGE
1500Vdc or peak AC.

CALIBRATION
Accuracy specifications guaranteed for one year, 20°C to 30°C.

MEASUREMENT RATE
Four measurements per second, nominal.

DC VOLTS

GENERAL
Automatic polarity indication (+ and - indicated)

INPUT IMPEDANCE
22 Megohms

NORMAL-MODE REJECTION
Greater than 60dB above 49Hz

COMMON-MODE REJECTION
Greater than 160dB up to 1500Vdc

RESPONSE TIME
Less than one second

OVERVOLTAGE PROTECTION
1500Vdc or peak AC, any range. 6kV transients, 10useconds.

		ACCURACY (1 year, 20°C to 30°C)		
RANGE	RESOLUTION	TECH 300 TECH 300A MODEL 3000	TECH 310 MODEL 3010	MODEL 3020 TECH 320B MODEL 3020B TECH 330 RMS 3030
±200mV	100µV	±(0.5% of reading + 1 digit)	±(0.25% of reading + 1 digit)	±(0.1% of reading + 1 digit)
±2V	1mV			
±20V	10mV			
±200V	0.1V			
±1500V	1V			

AC VOLTS

EXTENDED FREQUENCY RESPONSE (RMS MODELS)
Typically ±3dB at 100kHz

CREST FACTOR (RMS MODELS)
Allowable crest factor (peak/rms ratio) varies from 1.0 to 5.0

CONVERSION TECHNIQUE
Non-RMS Models: Average sensing, calibrated to display RMS value of sine wave.
RMS Models: True RMS responding.

INPUT IMPEDANCE (ALL RANGES)
2.2 Megohms, shunted by less than 75pF

RESPONSE TIME
Less than two seconds (on some models, above 10% of fullscale)

OVERVOLTAGE PROTECTIONS
Non-RMS Models: 1000Vrms AC (1500V peak) or 600Vdc (five seconds maximum above 450Vrms on 200mV range)
RMS Models: AC only: 1000Vrms/1500V peak AC or 600Vdc
AC + DC: 1000V maximum DC + AC RMS, with 600Vdc maximum.

TECH 300, TECH 300A, and MODEL 3000

		ACCURACY (1 year, 20°C to 30°C)		
RANGE	RESOLUTION	45Hz to 2kHz	2kHz to 5kHz	5kHz to 10kHz
200mV 2V 20V 200V 1000V	100µV 1mV 10mV 0.1V 1V	±(1.5% of reading + 4 digits)	±(2.0% of reading + 5 digits)	±(3.0% of reading + 9 digits)

TECH 310 and MODEL 3010

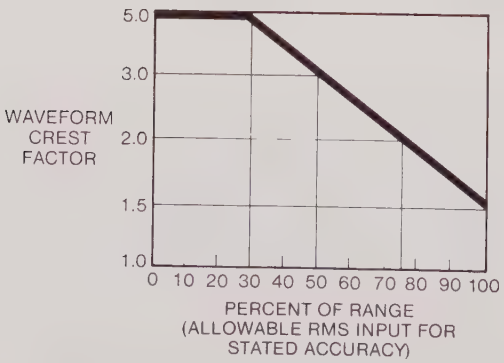
		ACCURACY (1 year, 20°C to 30°C)		
RANGE	RESOLUTION	45Hz to 2kHz	2kHz to 5kHz	5kHz to 10kHz
200mV 2V 20V 200V 1000V	100µV 1mV 10mV 0.1V 1V	±(0.75% reading + 3 digits)	±(1.5% reading + 5 digits)	±(2.5% reading + 9 digits)

TECH 320B, MODEL 3020, MODEL 3020B

		ACCURACY (1 year, 20°C to 30°C)		
RANGE	RESOLUTION	45Hz to 2kHz	2kHz to 5kHz	5kHz to 10kHz
200mV 2V 20V 200V 1000V	100µV 1mV 10mV 0.1V 1V	±(0.6% of reading + 3 digits)	±(1.0% of reading + 5 digits)	±(2.0% of reading + 9 digits)

TECH 330 and RMS 3030

		ACCURACY (1 year, 20°C to 30°C)				
RANGE	RESOLUTION	45Hz to 2kHz	2kHz to 5kHz	5kHz to 10kHz	10kHz to 20kHz	20kHz to 40kHz
200mV 2V 20V 200V 1000V	100uV 1mV 10mV 0.1V 1V	±(0.6% reading + 3 digits)	±(1.0% reading + 4 digits)	±(1.5% reading + 5 digits)	±(2.0% reading + 7 digits)	±(5% reading + 15 digits) --- Not Specified



DC CURRENT

GENERAL
Automatic polarity indication (+ and - indicated)

RESPONSE TIME
Less than one second

VOLTAGE BURDEN
200uA to 200mA ranges: 250mV maximum at fullscale
2A and 10A ranges: 700mV maximum at fullscale

OVERCURRENT PROTECTION -- 2A INPUT
Two amperes, 250V (fused)

OVERCURRENT PROTECTION -- 10A INPUT
(not included on Tech 300, Tech 300A and Model 3000)
Up to 20 amperes for fifteen seconds (unfused)

		ACCURACY (1 year, 20°C to 30°C)		
RANGE	RESOLUTION	TECH 300 TECH 300A MODEL 3000	TECH 310 MODEL 3010	MODEL 3020 TECH 320B MODEL 3020B TECH 330 RMS 3030
±200uA	100nA	±(1.0% reading + 1 digit)	±(0.75% reading + 1 digit)	±(0.35% reading + 1 digit)
±2mA	1µA			
±20mA	10µA			
±200mA	100µA			
±2A	1mA			
±10A	10mA		±(1.5% reading + 1 digit)	±(1.0% reading + 1 digit)

AC CURRENT

CREST FACTOR (RMS MODELS)
1:1 to 5:1, refer to functional description - Section 2.

CONVERSION TECHNIQUE
Non-RMS Models: Average sensing, calibrated to display RMS value of sine wave.
RMS Models: True RMS responding (AC + DC)

RESPONSE TIME
Less than two seconds, typical (input above 10% of fullscale).

VOLTAGE BURDEN
200uA to 200mA ranges: 250mV maximum at fullscale.
2A and 10A ranges: 700mV maximum at fullscale.

OVERCURRENT PROTECTION -- 2A INPUT
2 amperes, 250V (fused).

OVERCURRENT PROTECTION -- 10A INPUT
(not included on Tech 300, Tech 300A , and Model 3000)
Up to 20 amperes for 15 seconds (unfused).

TECH 300, TECH 300A, MODEL 3000

		ACCURACY (1 year, 20°C to 30°C)	
RANGE	RESOLUTION	45Hz to 400Hz	400Hz to 2kHz
200uA 2mA 20mA 200mA 2A	100nA 1µA 10µA 100uA 1mA	±(2.0% of reading + 4 digits)	±(2.0% of reading + 3 digits)

AC CURRENT (cont'd)

TECH 310 and MODEL 3010

		ACCURACY (1 year, 20°C to 30°C)		
RANGE	RESOLUTION	45Hz to 400Hz	400Hz to 2kHz	2kHz to 5kHz
200uA 2mA 20mA 200mA 2A 10A	100nA 1µA 10µA 100uA 1mA 10mA	±(1.5% of reading + 3 digits) ±(2.0% of reading + 3 digits)	±(1.5% of reading + 3 digits)	±(1.5% of reading + 3 digits)

MODEL 3020
TECH 320B MODEL 3020B
TECH 330 RMS 3030

		ACCURACY (1 year, 20°C to 30°C)		
RANGE	RESOLUTION	45Hz to 400Hz	400Hz to 2kHz	2kHz to 5kHz
200uA 2mA 20mA 200mA 2A 10A	100nA 1µA 10µA 100uA 1mA 10mA	±(0.9% of reading + 3 digits) ±(1.5% of reading + 3 digits)	±(0.9% of reading + 3 digits)	±(1.5% of reading + 3 digits)

RESISTANCE

GENERAL
Low power ohms on all ranges, except 20-ohm range.

MAXIMUM OPEN-CIRCUIT VOLTAGE
0.5V, all ranges except 7V on 20V range.

MAXIMUM IN-RANGE VOLTAGE (Low-Power Ohms)
250mV, all ranges

RESPONSE TIME
Less than one second, except on 20Megohm range - less than four seconds.

OVERLOAD PROTECTION
Non-MOV models: 300 VDC or RMS AC, any range
MOV models: 500 VDC or RMS AC, any range

			ACCURACY (1 year, 20°C to 30°C)		
RANGE	RESOLUTION	MAX. TEST CURRENT	TECH 300 TECH 300A MODEL 3000	TECH 310 MODEL 3010	MODEL 3020 TECH 320B MODEL 3020B TECH 330 RMS 3030
200Ω	0.1Ω	2.5mA	±(0.75% of reading + 1 digit)	±(0.2% of reading + 1 digit)	±(0.5% of reading + 1 digit)
2kΩ	1Ω	250µA			
20kΩ	10Ω	25µA			
200kΩ	100Ω	2.5uA			
2MΩ	1000Ω	250nA			
20MΩ	10kΩ	25nA	±(1.5% of reading + 1 digit)	±(1.0% of reading + 1 digit)	±(1.5% of reading + 1 digit)

TEMPERATURE

INPUT JACK
Accepts industry standard miniature and subminiature thermocouple

SENSING RANGE
-20°C to 1265°C

RESOLUTION
1°C

ACCURACY (at 25°C ambient)
±4°C (-20°C to 300°C)
±3% reading (300°C to 1265°C)

CORRECTION
NBS K-type thermocouple table.
Corrected to 1971 NBS Thermocouple table for ANSI
K-type thermocouple junction.

COLD JUNCTION CORRECTION
±1°C, 0°C to 50°C ambient.

DIODE TEST MEASUREMENT SPECIFICATIONS

RANGE
0 to 2V

RESOLUTION
1mV

TEST CURRENT
Non-MOV models: 5mA, +10%
MOV models: 2mA, +10%

RESPONSE TIME
less than one second

OVERLOAD PROTECTION
Non-MOV models: 300 VDC or RMS AC
MOV models: 500 VDC or RMS AC

INSTA-OHMS SPECIFICATIONS
(not available on Tech 300, Tech 300A, Model 3000)

RESPONSE TIME
Less than 100 milliseconds

TECH 350, TECH 360, MODEL 3050, MODEL 3060 SPECIFICATIONS

Accuracies are ± (% of reading + no. of digits). Guaranteed for 1 year, 25°C, ± 5°C.

GENERAL

	TECH 350,3050	TECH 360,3060
Operating Temperature	0° to +50°C	
Storage Temperature	-40°C to +65°C, battery removed	
Maximum Common Mode Voltage	1500Vdc or peak ac	
Display	3½-digit LCD (1999 max. count)	
Power	Six heavy-duty size D batteries	
Battery Life	12,000 hours (18 months) continuous typical, four years normal, 8 hours/day	
Low Battery Indicator	Decimal point blinks, indicating 10% of battery life remains	
Shock and Vibration	Meets MIL-T-28800 specifications	
Relative Humidity	0-80%, 0 to 35°C; 0-70%, 35°C to 50°C	
Temperature Coefficient	Less than 15% of applicable accuracy spec. per °C (0°C to 20°C, 30°C to 50°C)	
Dimensions	7.00 in. L x 8.5 in. W x 3.4 in. H (17.8 cm L x 23.6 cm W x 8.6 cm H)	
Case Material	High impact, fire retardant, ABS plastic	
Weight	58 oz. (1647g) including batteries	
Calibration	Accuracy specification guaranteed for 1 year	
Calibration Adjustments	One Adjustment	Five Adjustments
Measurement Rate	4 measurements per second, nominal	

TECH 350, TECH 360, MODEL 3050, MODEL 3060 SPECIFICATIONS

Accuracies are ± (% of reading + no. of digits). Guaranteed for 1 year, 25°C, ± 5°C.

DC VOLTAGE

	TECH 350,3050 / TECH 360,3060
Ranges	± 200mV,2V,20V,200V,1500V
Resolution	100µV on 200mV range
Accuracy	0.1% rdg. + 1 digit
Input Impedance	22MΩ, all ranges
Normal Mode Rejection	>60dB above 49Hz
Common Mode Rejection	>160dB up to 1500Vdc
Response Time	Less than 1 second
Overvoltage Protection	1500 Vdc or peak ac, any range 6kV transients, 10µsec.

DC CURRENT

	TECH 350,3050 / TECH 360,3060
Ranges	200µA,2mA,20mA,200mA,2A,10A
Resolution	100nA on 200µA range
Accuracy 200µA to 2A ranges 10A range	 0.35% rdg. + 1 digit 1.0% rdg. + 1 digit
Response Time	Less than 1 second
Voltage Burden	300mV maximum at fullscale except 2A and 10A ranges, 800mV
Overcurrent Protection (A input)	2 Amps/250V front panel fuse in series with 3A/600V internal fuse
Overcurrent Protection (10A input)	10 Amps continuous and up to 20 Amps for 15 seconds (unfused)

TECH 350, TECH 360, MODEL 3050, MODEL 3060 SPECIFICATIONS

Accuracies are ± (% of reading + no. of digits). Guaranteed for 1 year, 25°C, ± 5°C.

AC VOLTAGE

	TECH 350, 3050	TECH 360, 3060
Ranges	200mV,2V,20V,200V,1000V	
Resolution	100µV on 200mV range	
Accuracy		
45Hz-2kHz	0.6% rdg. + 3 digit	0.6% rdg. + 3 digit
2kHz-5kHz	1.0% rdg. + 5 digit	1.0% rdg. + 4 digit
5kHz-10kHz	2.0% rdg. + 9 digit	1.5% rdg. + 5 digit
10kHz-20kHz	Not Specified	2.0% rdg. + 7 digit
Input Impedance	2.2MΩ shunted by <100 pF.	
Response Time	Less than 2 seconds*	
Overvoltage Protection	1000Vrms/1500V peak ac or 600Vdc	ac only: 1000Vrms/ 1500V peak ac or 600Vdc ac + dc: 1000V max ac + dc RMS
	5 seconds maximum above 450Vrms, 20mV range; 6kV transients, 10µsec.	
Crest Factor**	Not Applicable	1:1 to 5:1
Conversion Type	Average sensing --- RMS calibrated sine wave	True RMS (ac + dc) or (ac only)
Coupling	ac	ac or (ac + dc)

* Response Time on TECH 360 and MODEL 3060 specified only for inputs above 10% of full scale

** Crest Factor = $\frac{\text{Peak Voltage}}{\text{RMS Voltage}}$

TECH 350, TECH 360, MODEL 3050, MODEL 3060 SPECIFICATIONS

Accuracies are ± (% of reading + no. of digits). Guaranteed for 1 year, 25°C, ± 5°C.

AC CURRENT

	TECH 350,3050	TECH 360,3060
Ranges	200µA,2mA,20mA,200mA,2A,10A	
Resolution	100nA on 200µA range	
Accuracy 45Hz-2kHz (except 10A)	0.9% rdg. + 3 digit	
2kHz-5kHz (except 2A and 10A ranges)	Not Specified	1.5% rdg. + 3 digit
45Hz-400Hz (10A range)	1.5% rdg. + 3 digit	
Conversion Type	Average sensing--- RMS calibrated wave	True RMS (ac + dc)
Response Time	Less than 2 seconds*	
Voltage Burden	300mV maximum at full scale except 2A and 10A ranges, 800mV	
Overcurrent Protection (2A input)	2 Amps/250V front panel fuse in series with 3A/600V internal fuse	
Overcurrent Protection (10A input)	10 Amps continuous and up to 20 Amps for 15 seconds (unfused)	

* Response Time on TECH 360 and MODEL 3060 specified only for inputs above 10% of full scale

TECH 350, TECH 360, MODEL 3050, MODEL 3060 SPECIFICATIONS

Accuracies are ± (% of reading + no. of digits). Guaranteed for 1 year, 25°C, ± 5°C.

RESISTANCE

	TECH 350,3050 / TECH 360,3060
Ranges	20Ω,200Ω,2kΩ,20kΩ,200kΩ,2MΩ,20MΩ
Resolution	0.01Ω on 20Ω range
Accuracy 20Ω range 200Ω to 2MΩ ranges 20MΩ range	 0.5% rdg. + 1 digit 0.2% rdg. + 1 digit 1.0% rdg. + 1 digit
Maximum Open Circuit Voltage	500mV (6V on 20Ω range)
Maximum In-Range Voltage	250mV
Maximum Test Current	2.5mA (4.6mA on 20Ω range)
Response Time	Less than 1 second, except 20MΩ range, less than 4 seconds
Overload Protection	440Vdc or rms ac any range

INSTA OHMS CONTINUITY INDICATOR

	TECH 350,3050 / TECH 360,3060
Response Time	100 Milliseconds
Audible Indicator	Nominal frequency = 3500Hz

TECH 350, TECH 360, MODEL 3050, MODEL 3060 SPECIFICATIONS

Accuracies are ± (% of reading + no. of digits). Guaranteed for 1 year, 25°C, ± 5°C.

DIODE TEST

	TECH 350,3050	TECH 360,3060
Range	0 to 1V	
Resolution	1mV	
Accuracy	0.1% rdg. + 2 digit	
Test Current	4mA, ± 10%	
Response Time	Less than 1 second	
Overload Protection	440Vdc or rms	

TEMPERATURE

	TECH 350,3050	TECH 360,3060
Range	Not Available	-20°C to +1265°C
Resolution	Not Available	1°C
Accuracy***	Not Available	± 4°C (-20°C to +300°C) ± 3% rdg. (300°C to +1265°C)
Connection	Not Available	Miniature or sub-miniature K-type thermocouple connector

*** Accuracy includes zero and calibration errors and NBS conformity, but does not include thermocouple errors

HD 100 SPECIFICATIONS

Accuracies are ± (% of reading + no. of digits). Guaranteed for one year, 25°C ± 5°C.

GENERAL

Operating Temp	0°C to +50°C
Storage Temp	-40°C to +65°C, battery removed
Max Common Mode V	1500Vdc or peak ac
Display	3½-digit LCD (1999 max count)
Power	Single std 9V battery, NEDA 1604
Battery Life	Alkaline: 2000 continuous hours typical-Zinc-carbon: 1600 continuous hours typical
Low Battery Ind	Decimal point blinks during last 200 hours of battery life
Shock & Vibration	Meets Mil-T-28800 specifications
Rel Humidity	0-80%,0°C to 35°C; 0-70%,35°C to 50°C
Tempco	Less than 15% of applicable accuracy spec per °C(0°C to 20°C,30°C to 50°C)
Dimensions	7.2 in. (18,3cm) L x 3.9 in. (9,9cm) W x 2.0 in. (5,1cm) H
Case Material	High impact, fire retardant, plastic
Weight	18 oz. (510g) including battery
Calibration	Accuracy specifications guaranteed for one year
Calibration Adj	One
Measurement Rate	Four measurements per second, nominal

HD 100 SPECIFICATIONS

Accuracies are ± (% of reading + no. of digits) Guaranteed for one year, 25°C ±5°C

DC VOLTAGE

Ranges	±200mV,2V,20V,200V,1500V
Resolution	100μV on 200mV range
Accuracy	0.25% rdg. +1
Input Impedance	22MΩ, all ranges
Normal Mode Rejection	>60 dB above 49Hz
Common Mode Rejection	>160 dB up to 1500Vdc
Response Time	Less than 1 second
Overvoltage Protection	1500Vdc or peak ac, any range

AC VOLTAGE

Ranges	200mV,2V,20V,200V,1000V
Resolution	100μV on 200mV range
Accuracy-45Hz- 2kHz 2Hz- 5kHz 5Hz- 10kHz	0.75% rdg. + 3 1.50% rdg. + 5 2.50% rdg. + 9
Conversion Type	Average sensing-RMS calibrated sine wave
Input Impedance	2.2MΩ shunted by <75pF
Response Time	Less than 2 seconds
Overvoltage Protection	1000Vrms/1500V peak ac or 250Vdc (5 sec. max above 450Vrms,200mV range)

HD 100 SPECIFICATIONS

Accuracies are ± (% of reading + no. of digits). Guaranteed for one year, 25°C ±5°C.

DC CURRENT

Ranges	200µA,2mA,20mA,200mA,2A
Resolution	100nA on 200µa range
Accuracy-200µA to 2A range	0.75% rdg. + 1
Response Time	Less than 1 second
Voltage Burden	250mV max at full scale except 2A 700mV
Overcurrent Protection (A Input)	2 amps/250V (fused)

AC CURRENT

Ranges	200µA,2mA,20mA,200mA,2A
Resolution	100nA on 200µA range
Accuracy-45Hz-2kHz	1.5% rdg. + 3
Conversion Type	Average sensing
Response Time	Less than 2 seconds
Voltage Burden	250mV max at full scale except 2A 700mV
Overcurrent Protection (A Input)	2 amps/250V (fused)

HD 100 SPECIFICATIONS

Accuracies are ± (% of reading + no. of digits. Guaranteed for one year, 25°C ±5°C.

RESISTANCE

Ranges	200Ω,2KΩ,20KΩ,200KΩ,2MΩ,20MΩ
Resolution	0.1Ω on 200Ω range
Accuracy-200Ω to 2MΩ Ranges 20MΩ Range	0.5% rdg. + 1 1.5% rdg. + 1
Maximum Open Circuit Voltage	500mV
Maximum in-Range Voltage	250mV
Max Test Current	2.5mA
Response Time	Less than 1 sec., except 20MΩ range, less than 4 sec.
Overload Protection	600Vdc or rms ac on any range

INSTA-OHMS CONTINUITY FUNCTION

Response Time	<100 milliseconds

DIODE TEST

Range	0 to 2V
Resolution	1mV
Accuracy	0.25% rdg. +2
Test Current	2mA, ±10%
Response Time	Less than 1 second
Overload Protection	600Vdc or rms ac on any range

283-679072

SECTION TWO
DETAILED FUNCTIONAL DESCRIPTION

GENERAL

The main functioning component of the Beckman Series 300 and Series 3000 Digital Multimeter is the custom-designed CMOS LSI Multiprocessor chip. This chip contains an active input filter, an averaging AC-to-DC converter, the Insta-Ohms detection, resistance measurement circuits, an analog-to-digital converter with ±200mVdc fullscale ratiometric inputs, and all necessary digital and LCD display drive circuits.

Additional peripheral components are used with the multiprocessor chip to perform a range of voltage, current, resistance, and semiconductor measurements, and to provide overall instrument protection.

Included in these peripheral components are the Function/Range Switch, three resistor networks, a voltage reference diode, several circuit protection components, the battery, and the display. The RMS-measuring models also contain an additional integrated circuit which permits true RMS conversion of the AC signals.

OPERATING FEATURES

A simplified block diagram of the Multimeter is shown in Figure 2-1.

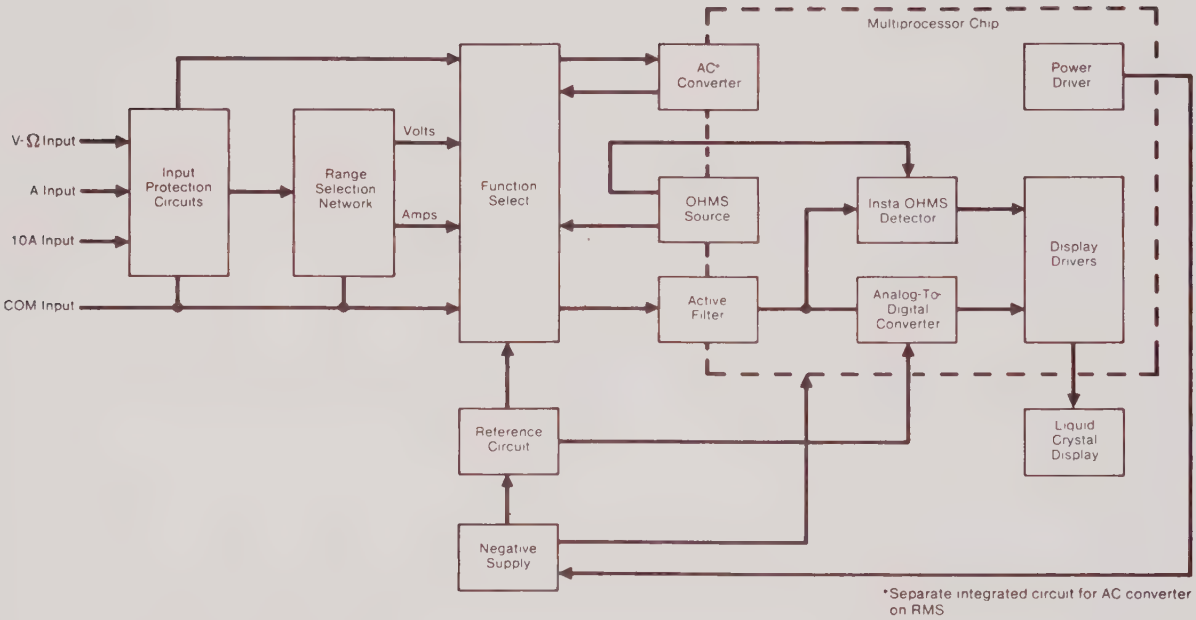


Figure 2-1. Multimeter Simplified Block Diagram

The Function/Range Switch routes an input signal to an input conditioning circuit. Here the signal is converted to a DC voltage between -200mV and +200mV. The signal is then processed by the multiprocessor chip. After being passed through an active filter for normal-mode rejection of interfering power line and audio frequency noise, the signal is converted to digital form by an analog-to-digital converter on the multiprocessor chip. The output from the ADC is presented as display segment driving signals, resulting in a display of the applied input signal.

Decimal point positions on the display are determined automatically by the multiprocessor chip based on the Function/Range Switch setting.

FUNCTIONAL ANALYSIS OF THE MULTIPROCESSOR CHIP

The multiprocessor chip contains the averaging AC converter, an active input filter, the Insta-Ohms detector, the analog-to-digital converter, circuits for controlling voltage polarity signs, overload indicator, low battery indicator, and all display drivers.

ANALOG-TO-DIGITAL CONVERTER

The analog-to-digital converter performs a true ratio voltage conversion between two input ports. One input to the ADC is the unknown input voltage. For all voltage and current measurements, the second (reference) port is connected to a precision voltage reference generated by a band gap diode (VR1) and a voltage divider network (U2). The reference voltage is set during calibration by an adjustment of the trimmer potentiometer(s).

When the unknown voltage exactly equals the reference voltage, a fullscale reading results from the ADC. As the ratio of the unknown voltage to the refence voltage decreases, proportionally lower readings result.

In the resistance ranges, The reference input is supplied by the voltage drop across a reference resistor connected in series with the unknown resistance.

ACTIVE FILTER

A second-order Bessel filter insures broadband normal-mode rejection of interfering powerline and audio frequencies. This, combined with the usual 6dB per octave rejection of the integrating converter, provides more than 60dB rejection at power line frequencies.

Insta-Ohms QUICK CONTINUITY INDICATOR

The Insta-Ohms feature allows a very quick determination of circuit continuity. The Insta-Ohms detector consists of a single-bit analog-to-digital converter triggered by a resistance less than double the maximum resistance measurable on a selected range. For example, on the 200Ω range, the symbol appears when less than 400Ω is detected by the Multimeter.

INPUT PROTECTION

Input protection circuits isolate the instrument from normally encountered overloads and range selection errors.

In the DC voltage range, primary overvoltage protection is provided by a two-Megohm series resistor (part of the active filter) working into voltage limiters included in the converter chip. Secondary protection from high voltages is provided by a 2-kilovolt spark gap (SG1) and a 2-kΩ resistor, or, in the latest versions, by a Metal Oxide Varistor. Continuous overloads of 1500Vdc and energy-limited transients of much higher voltage can be tolerated.

On all resistance ranges and on the diode test function, a positive temperature coefficient resistor (R10) and two zener diodes (VR2, VR3) provide isolation from the application of external voltages.

In the current mode, protection is provided by the combination of a diode limiter bridge (BR1) and a 2-ampere 250-volt fuse (F1). The diodes will divert the overloads from the current measurement resistors and the fuse will blow for long-term overloads. Bench meters also include a 3-ampere 600-volt fuse (F2) that will blow when voltages are high enough to arc across F1. Fuse F2 is provided for operator protection only; meter damage may occur.

Although not fuse-protected, the 10-ampere current input connects directly into a current shunt resistor that can withstand 10 amperes continuously and up to 20 amperes for a moderate duration.

INPUT SIGNAL CONDITIONING

The analog-to-digital converter on the multiprocessor chip converts an unknown voltage in the range of -200mVdc to +200mVdc into a digital equivalent for display. If the measured signal is not a DC voltage in the ±200mV range, it must be scaled down and converted to a DC voltage before being presented to the ADC.

1) AC and DC Voltage Precision-Divider Network.
If the ±200mVdc range is selected, the input signal feeds directly into the multiprocessor chip through the active filter network. On all other high DC voltage ranges, a precise power-often voltage is selected from the voltage divider as the multiprocessor input.

A precision-ratio resistor network is used as the voltage divider for both the AC and DC voltage ranges. The voltage divider is part of a Beckman thin-film resistor network (U1).

If an AC voltage range is selected, voltage divider output is coupled to an AC converter which in turn provides a proportional output for the active filter input to the multiprocessor chip. On models of the Multimeter that perform RMS measurement, C19 forms part of a parallel capacitive divider to balance the resistance divider at higher frequency. This allows full advantage to be taken of the greater accuracy inherent in the true RMS converter.

2) Average Response AC Measurements.
In models of the Multimeter that do not perform true RMS conversion, the AC converter used is "average responding". An RMS value is determined by first rectifying and filtering the signal to obtain an average value. The average value is then scaled upward by a factor of 1.11 to obtain the displayed value. The scaling factor of 1.11 is accurate in the RMS measurement of pure sine wave signals.

In measuring non-sinusoidal waveforms, however, significant errors can be introduced because of different scaling factors relating averages to RMS values. Rough correction factors can sometimes be calculated for standard waveforms which are free from significant noise and distortion, but accurate measurements of complex waveforms are sometimes difficult to achieve.

3) AC Measurements with True RMS Multimeters.
RMS values for non-sinusoidal AC signals are measured directly and more accurately with the multimeters featuring a "true RMS responding" AC converter. True RMS AC response is particularly useful in measuring complex or noisy signals for which even rough correction factors are not easily computed.

AC converters of all types are limited by their frequency response and input dynamic range. Bandwidth defines the range of frequencies in which the conversion accuracy is within 3dB. Bandwidth for these meters is typically 100kHz.

The Tech 330 and Model RMS 3030 Multimeters measure the total (AC + DC) RMS value of a waveform. The Tech 360 and Model RMS 3060 are switch-selectable, allowing measurement of either total (AC + DC) RMS or AC only RMS value of a waveform. In measuring the total (AC + DC) voltage of a waveform, Crest Factor is used.

Crest factor is a measure of the input dynamic range of a true-RMS responding AC converter. It expresses the ability of the AC converter to handle a signal that has large peak values compared to its RMS value without saturating the converter circuit and degrading the specific accuracy.

For true RMS measuring meters, crest factor is defined as the ratio of the peak voltage to the total RMS (AC + DC) voltage.

$$\text{Crest Factor} = \frac{\text{Vpeak}}{\text{Vrms}}$$

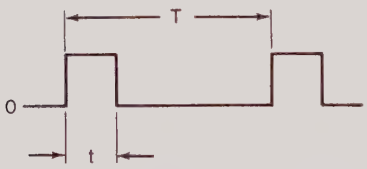
Crest factors for models which feature RMS conversion range from 1.0 to 5.0 on each voltage scale depending on the RMS value of the signal being measured. At fullscale (1999 counts), signals with crest factors between 1.0 to 5.0 can be measured. Signals with crest factors of 1.0 include a square wave or pure DC (peak voltage equals RMS voltage). An undistorted sine wave signal (crest factor = 1.414) as well as a sine wave with considerable harmonic distortion can both be accurately measured at fullscale.

At halfscale (1000 counts), signals with a crest factor between 1.0 and 3.0 can be measured without performance degradation. At 600 counts and below, signals with crest factors up to 5.0 can be measured. If the crest factor of a waveform is not known, it can be determined by measuring the peak voltage with an oscilloscope and dividing by the RMS voltage measured by the Multimeter. The crest factors of some typical waveforms are shown in Figure 2-2.

Crest factor for a pulse train is also related to duty cycle (D) as follows:

$$\text{Crest Factor} = \sqrt{\frac{1}{D}}$$

$$\text{where } D = \frac{t}{T}$$



Waveform	Crest Factor
Sine Wave	1.414
Sawtooth	1.732
Half-Wave Rectified Sine Wave	2.0
SCR Output 100% to 10%	1.414 to 3.0
Rectangular Pulse 50% ≥ D ≥ 10%	1.414 to 3.16

Figure 2-2. Typical Waveform Creast Factors

On the Tech 360 and Model RMS 3060, the RMS value of "AC only" signals is obtained by using a true RMS converter chip (U3). These meters calculate the RMS value of an input voltage by performing the electronic equivalent of the actual mathematical function:

$$V_{rms} = \sqrt{\frac{1}{T}\int_0^T V_{IN}^2(t)\,dt}$$

4) Current Range.

Current is converted to a DC voltage by passing the current through a selected shunt resistor, resulting in a (IR) voltage drop within the ±200mV range required by the multiprocessor chip. This process assures that the maximum voltage burden or voltage dropped through the current sense resistor is less than 0.25V.

The resistors that are switched in series to make current shunt values from 0.1Ω to 1 kΩ are part of the thin-film network U1 and wirewound resistors R3, R4, and R5. The 0.01 shunt for the 10 ampere current range is a separate resistance component that is switched in automatically when a test lead is fully inserted into the 10A input.

The voltage drop from a DC current measurement is routed directly to the multiprocessor chip. In AC current ranges, the shunt voltage drop is routed to the same AC converter used in the conversion of AC voltages.

RESISTANCE MEASUREMENTS

Resistance measurements are made using a ratio technique where the unknown resistance is compared to an internal standard. The unknown resistance is connected in series with a selected reference resistor to a bias voltage (approximately 400mV) generated by the multiprocessor chip. See Figure 2-3.

The reference resistor is selected from the input attenuator network to be equal to the fullscale range of the unknown resistor being measured. For example, if the 20kΩ range is selected, a precision 20kΩ resistor is switched across the reference input. Reference resistors are selected from the same thin-film resistor network (U1) used as the voltage divider for voltage measurements. Because of negligible loading at the sensing terminals by the multiprocessor chip, the ratio of the two resistors is equal to the ratio of their respective voltage drops.

$$\frac{V_x}{R_x} = \frac{V_{ref}}{R_{ref}}$$

The analog-to-digital converter on the multiprocessor chip uses a ratiometric conversion technique which relies solely on the ratio of the unknown voltage, V_x, to a reference voltage, V_{ref}. Choosing a low bias voltage assures that the voltage developed across the unknown resistance is 0.25 volt maximum. This allows low voltage testing of resistors in circuits where the presence of semiconductor junctions could otherwise affect measurement accuracy.

DIODE MEASUREMENTS

Refer to Figure 2-3. This operating mode provides a repeatable and easily understandable means to check semiconductor junctions. In this mode, the Multimeter operates with a very small fullscale DC measurement range, and the Ohms Bias Voltage circuit becomes a current source. This constant current source forces a small amount of current via the volt/ohm terminal into the semiconductor junction under test. The result is a voltage drop, scaled to within ±200mV by the voltage divider and converted in the multiprocessor chip for display. Reverse connection of test leads (for checking diode blocking) will normally display OL.

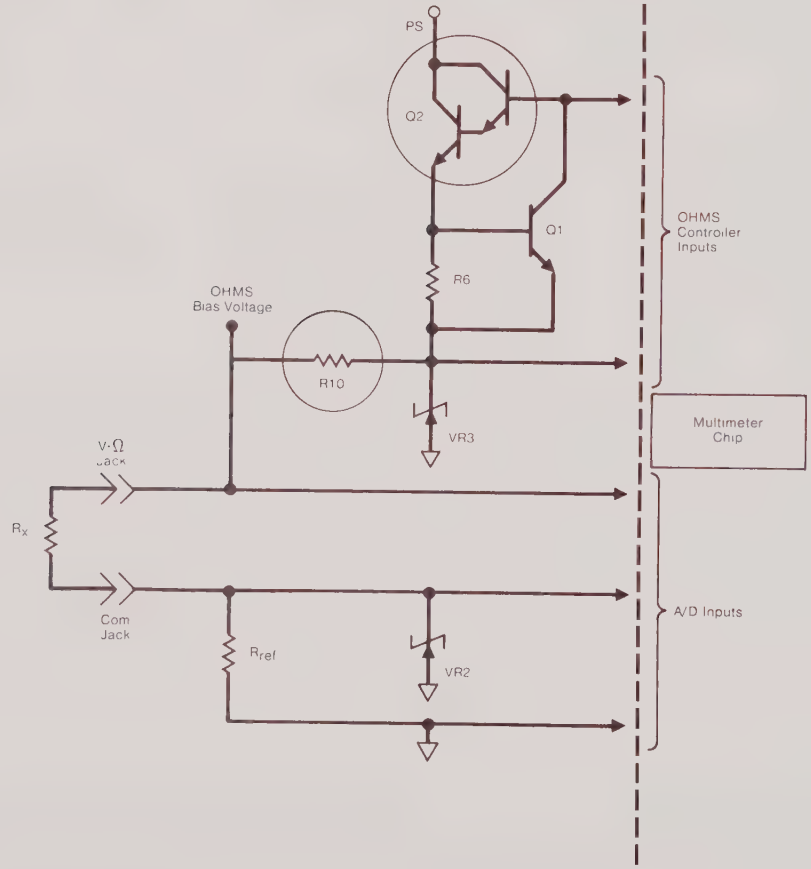


Figure 2-3. Circuit for Resistance Measurements

283-679073

GENERAL

This section contains procedures for calibration, maintenance, and repair of the Series 300 and Series 3000 Multimeters. Also included are procedures for Multimeter disassembly, component replacement, and Function/Range Switch disassembly and check procedures. If you are uncertain about what maintenance and service to perform, refer to Section Four, Troubleshooting.

SERVICING POLICY

ONE-YEAR LIMITED WARRANTY POLICY ON NEW INSTRUMENTS

The Beckman digital Multimeter is warranted in its entirety against any defects of material or workmanship which develop for any reason whatsoever, except abuse, within a period of one (1) year following the date of purchase of the Multimeter by the original purchaser. This warranty is extended by Beckman Instruments, Inc. (Beckman), only to the original purchaser or original user of the Multimeter, who must, as a CONDITION PRECEDENT TO WARRANTY COVERAGE AND PERFORMANCE THEREUNDER BY BECKMAN, complete and return the Warranty Registration Card, received on purchase of the Multimeter.

In the event a defect develops during the warranty period, Beckman will, at Beckman's election, repair or replace the Multimeter with a new or reconditioned model of equivalent quality. To obtain performance of any obligation of Beckman under the warranty, the original purchaser or original user must return the defective Multimeter, postage prepaid, along with a handling charge of $3.00 (prices subject to change), to:

Beckman Instruments, Inc.
210 S. Ranger Street, Box 3100
Brea, CA 92621
Attention: Customer Service

or to any other authorized Beckman Service Center.

In the event of replacement with a new or reconditioned model, the replacement unit will continue the warranty period of the original Multimeter. Replacement units will be returned by air, typically with only one (1) working day turnaround at the Service Center.

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ANY IMPLIED WARRANTIES ARISING OUT OF THE SALE OF THE MULTIMETER, INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE LIMITED IN DURATION TO THE ABOVE-STATED ONE (1) YEAR PERIOD. BECKMAN SHALL NOT BE LIABLE FOR LOSS OF USE OF THE MULTIMETER OR OTHER INCIDENTAL OR CONSEQUENTIAL DAMAGES, EXPENSES, OR ECONOMIC LOSS OR FOR ANY CLAIM OR CLAIMS FOR SUCH DAMAGE, EXPENSES OR ECONOMIC LOSS.

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Some states do not allow limitations on how long implied warranties last or the exclusion or limitations of incidental or consequential damages, so the above limitations or exclusions may not apply to you.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

AFTER-WARRANTY REPAIR OR EXCHANGE SERVICE

After-warranty service is provided by Beckman in two ways. You may elect to have your instrument repaired at an authorized Beckman repair facility, or you can exchange your defective out-of-warranty instrument for a reconditioned instrument at a flat rate contained on Beckman's current price list. The replacement unit carries a three (3) month limited warranty. Contact any authorized Beckman Distributor or Beckman Instruments, Inc., for the current non-warranty replacement rates and instructions for shipping the instrument.

CALIBRATION SERVICE

Each Beckman Multimeter should be calibrated at least once a year or after it is repaired. A procedure to accomplish this is contained in this section. If you do not have the necessary equipment specified to accomplish calibration, this service can be performed by an authorized Beckman Service Center. If you wish to take advantage of this service, contact any authorized Beckman distributor, repair facility, or Beckman Instruments, Inc., for current calibration rates and instructions for shipping the instrument.

SERVICING PROCEDURES FOR HAND-HELD METERS

MULTIMETER DISASSEMBLY PROCEDURE

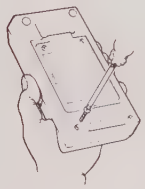
Before performing any of the Multimeter servicing, it is necessary to disassemble the instrument according to the directions given in Figure 3-1.

After performing the service or inspection, reassembly the instrument according to Figure 3-1.

CAUTION: Always turn instrument off and disconnect test leads before disassembly.

DISASSEMBLY

1. Remove four screws and carefully lift off back cover. This exposes Multimeter for basic servicing and for further disassembly, inspection, and repair.

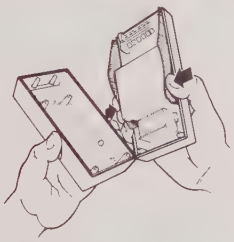


REASSEMBLY

2. Hold Multimeter back cover in your left hand and front cover in your right hand. Press foil shield inward between fingers of your right hand as shown.

CAUTION

Be sure to follow the directions for instrument reassembly closely; as improper reassembly can damage the foil shield, resulting in improper operation of the multimeter.



3. Hinge front bottom to rear bottom of Multimeter. Then carefully mate the front and rear of Multimeter as shown, being careful to hold foil so that it goes inside housing without getting bent or crushed.

4. Press Multimeter front and rear together. Reinstall and carefully tighten four screws in back cover.

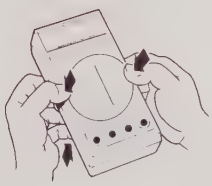


Figure 3-1. Multimeter Disassembly and Reassembly Procedure

BATTERY REPLACEMENT

CAUTION

To prevent electrical shock hazard, turn off Multimeter and disconnect test leads before removing back cover.

1. After disconnecting test leads and turning off Multimeter, remove back cover by removing four screws, Figure 3-1, then lift off back cover.

> CAUTION
> Failure to turn off instrument before installing battery could result in damage to battery if it is connected incorrectly to terminals.

2. Disconnect battery from instrument and replace with new standard 9-volt transistor battery (see Figure 3-2).

3. Replace back cover and secure with four screws.

> WARNING
> Do not operate Multimeter with back cover removed (except during calibration).

FUSE REPLACEMENT

> CAUTION
> To prevent electrical shock hazard, turn off Multimeter and disconnect test leads before removing back cover.

1. After disconnecting test leads and turning off Multimeter, remove back cover.

2. The fuse is located in the upper half of the instrument, Figure 3-2.

3. Remove the old fuse and replace with good fuse. If spare fuse is missing, replace it also.

> CAUTION
> To prevent fire, use only type AGX 2A/250V fuse.

4. Replace back cover and secure with four screws.

> WARNING
> Do not operate Multimeter with back cover removed (except during calibration).

MULTIPROCESSOR CHIP AND LIQUID
CRYSTAL DISPLAY REPLACEMENT

If you have determined that either the multiprocessor chip or the display need to be replaced, this can be accomplished by following the procedure in Figure 3-3.

ELASTOMER STRIPS CLEANING AND
REPLACEMENT PROCEDURE

If display segments do not function or if a corrective action step in the troubleshooting guide instructs you to inspect or replace an elastomer strip,

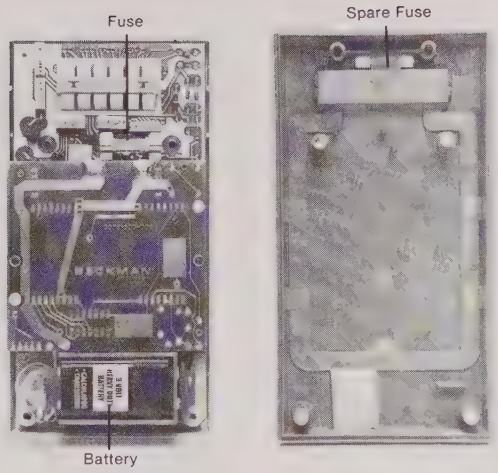


Figure 3-2. Multimeter, Internal View

access to these connectors can be gained by performing the procedure in Figure 3-3. Strips can be cleaned by dusting with a short-bristle camel's hair brush. If grease or fingerprint contamination is suspected, the strip may be washed in clean alcohol and air-dried. Do not wipe off with fibrous material as excessive lint can cause poor connections.

SMALL CIRCUIT BOARD INSPECTION AND REPLACEMENT PROCEDURE

Inspecting the small circuit board to determine if the Function/Range Switch is working properly or replacement of the small circuit board because of faulty operation requires following the procedure in Figure 3-4.

1. After removing back cover of multimeter (as shown in Figure 3-1), remove battery and battery case. Disconnect female input connectors with needle-nosed pliers.

NOTE

Pull straight down on connectors to avoid bending pins.

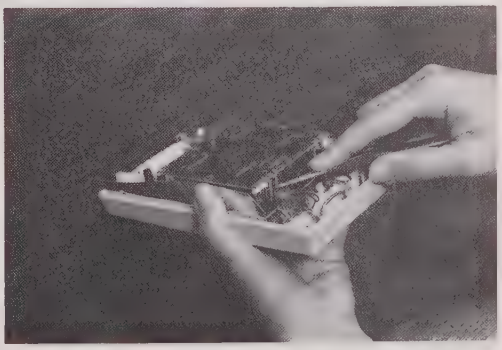
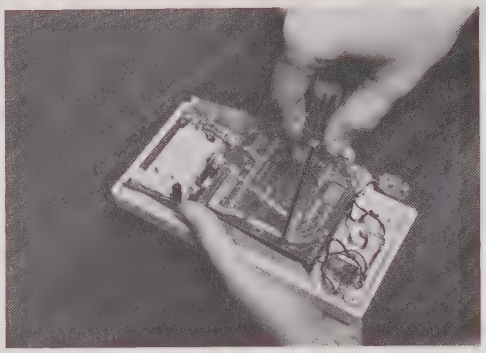


Figure 3-3. Disassembly and Replacement Procedure — Liquid Crystal Display and Multiprocessor Chip

2. Remove two No. 6 screws from rear of small circuit board.



3. Grasp outer edge of circuit boards and gently separate them from the front cover assembly.

CAUTION

Circuit boards are static sensitive -- handle by edges only.

4. With electronics assembly facing downward, squeeze together the prongs holding the retainer bar. Apply light pressure downward to free retainer from prongs. Repeat the second set of prongs.

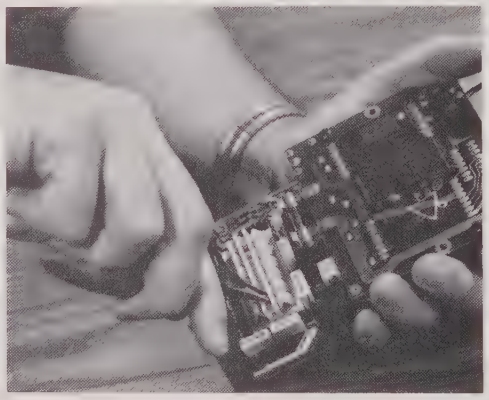


Figure 3-3. Disassembly and Replacement Procedure — Liquid Crystal Display and Multiprocessor Chip (continued)

5. Again squeeze prongs if necessary and carefully remove multiprocessor chip.

CAUTION

Multiprocessor chip is an extremely sensitive MOS device. Handle chip with approved procedure (using forceps, grounding bracelet, etc.).

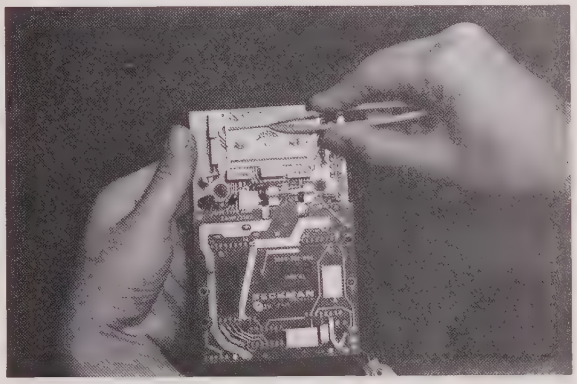
NOTE

If you are replacing only the multiprocessor chip, proceed to Step 16. If replacing the display, go on to Step 6.

6. Using forceps, carefully remove the two elastomer (zebra) strips from the multiprocessor chip holder.

CAUTION

DO NOT pinch zebra strips or touch them with your fingers. They can easily become crushed or contaminated, impairing conductivity.



7. Once again, squeeze prongs together and remove the display face and chip retainer from the circuit board.

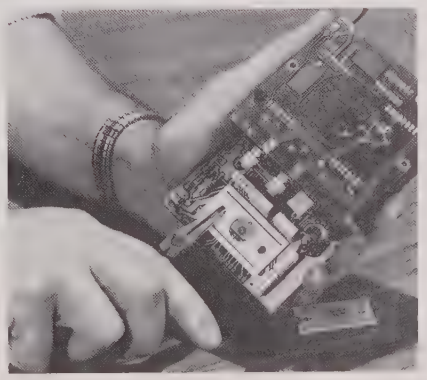
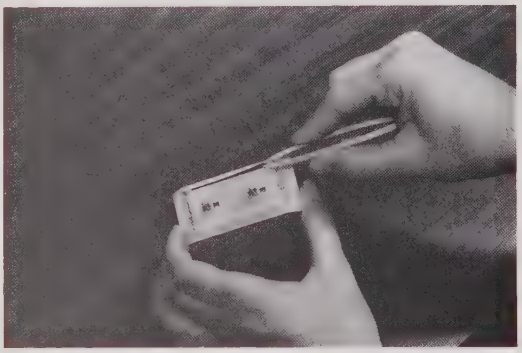


Figure 3-3. Disassembly and Replacement Procedure — Liquid Crystal Display and Multiprocessor Chip (continued)

8. Using caution, remove zebra strip from top of display retaining assembly.



9. To remove liquid crystal display, insert a small flat blade screwdriver between the retainer and the faceplate. Gently pry along the edge to unlatch all tabs, then remove retainer.

10. Remove LCD display, taking care to touch only the edges of the glass.

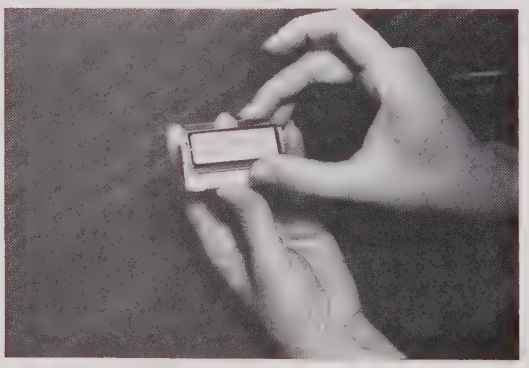
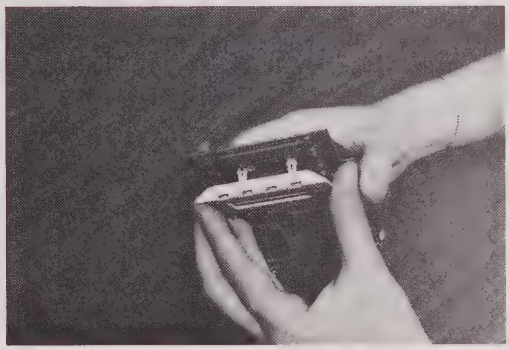


Figure 3-3. Disassembly and Replacement Procedure — Liquid Crystal Display and Multiprocessor Chip (continued)

11. Place new display face-down into faceplate. Notice which edge of the LCD has stripes in the glass -- this is the connector edge. Align the clear retainer over the rear of the display by matching the slot for the zebra strip with the connector edge of the LCD. Snap retainer into place, making sure that all tabs are fully engaged.

12. Replace zebra strip in slot at edge of retainer.

13. Position display assembly with zebra strip toward top of circuit board. Insert display assembly prongs into two holes on large circuit board. Snap together by applying gentle pressure and squeezing prongs together.



14. Place multiprocessor chip holder onto tabs. Make sure the indexing boss on right-hand underside of holder is inserted into index hole in the circuit board.

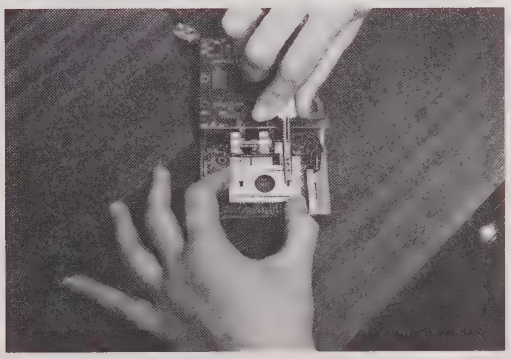
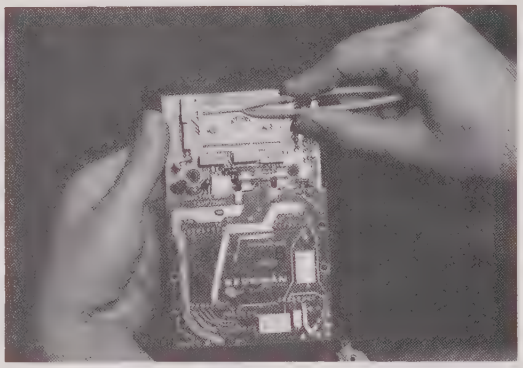


Figure 3-3. Disassembly and Replacement Procedure — Liquid Crystal Display and Multiprocessor Chip (continued)

15. Insert two cleaned or new zebra strips into slots on chip retainer. (Reference "Elastomer Strips Cleaning Procedure" documented earlier in Section 3.)

CAUTION

Avoid pinching zebra strips or touching them with your fingers.



16. Carefully place multiprocessor chip onto holder, gold connector side toward the circuit board. Align notch on side of chip with tab on side of chip holder.

17. Install chip retainer over chip and two prongs. Press downward with firm, even pressure until prongs are spread outward, holding retainer in place.

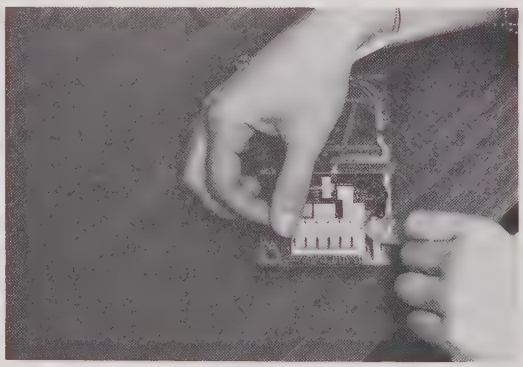


Figure 3-3. Disassembly and Replacement Procedure — Liquid Crystal Display and Multiprocessor Chip (continued)

18. Insert electronics assembly into front cover. It may be necessary to turn the Function/Range knob on the front of the meter so that its shaft will align with the opening in the cam on the circuit board.

19. Insert two screws into back of circuit board assembly and tighten.

20. Push female input connectors onto pins protruding from small circuit board. Be sure that these connectors fit snugly. Position leads so they will not be pinched by battery pack or between housings.

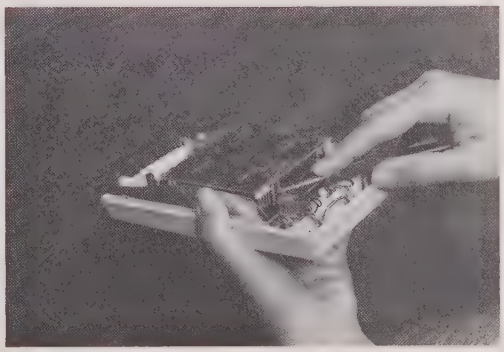
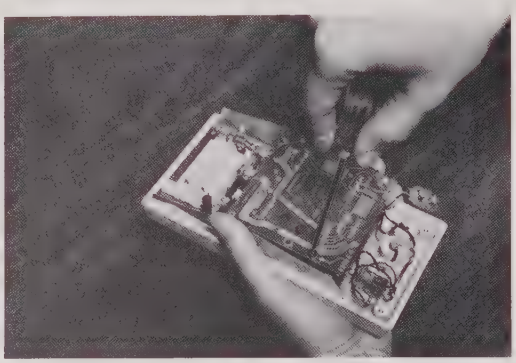


Figure 3-3. Disassembly and Replacement Procedure — Liquid Crystal Display and Multiprocessor Chip (continued)

21. Reinstall battery into battery pack and connect plug. Place battery pack onto mounting slots provided. Route leads so they will not be pinched or contact input terminals.

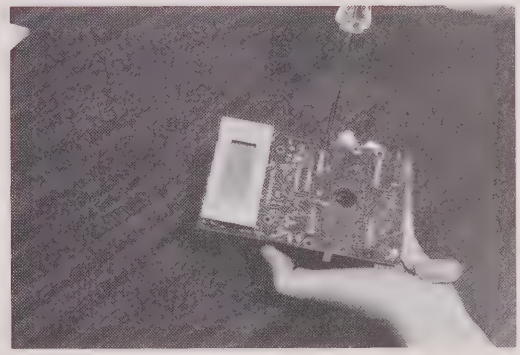


22. Reassemble multimeter according to procedure in Figure 3-1.

Figure 3-3. Disassembly and Replacement Procedure — Liquid Crystal Display and Multiprocessor Chip (continued)

1. Remove electronics assembly from multimeter housing as described in Figure 3-3.

2. Place electronics assembly on a flat surface with display facing upward. Remove two screws.



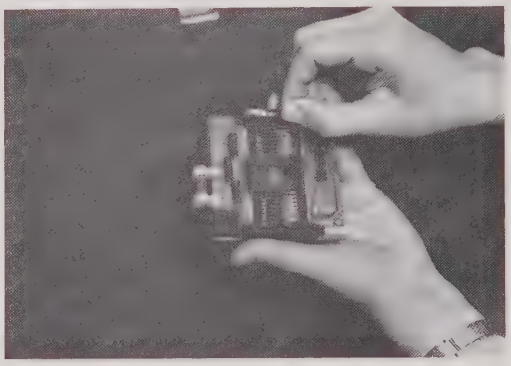
3. Holding circuit boards by outer edges, gently pull the two boards apart.

CAUTION

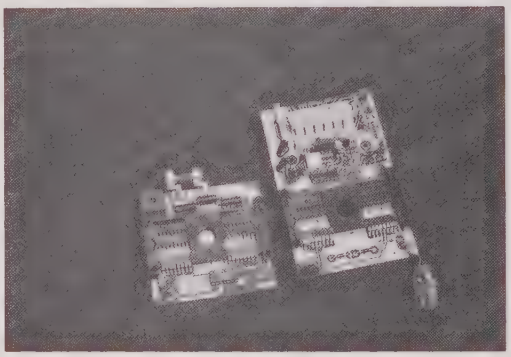
Damage to Function/Range Switch may result if circuit boards are not pulled straight apart as shown.

Figure 3-4. Removal, Replacement and Inspection Procedure for Electronics Assembly

4. Carefully remove switch cam from circuit board and remove detent spring from switch block.



5. Disassembly is not complete and multimeter is exposed for inspection, repair, or replacement of parts. After these are completed, proceed to Step 6 for reassembly.



6. Carefully engage cam onto large circuit board assembly. T-slotted hub of cam should fit downward into hole.

CAUTION

Do not engage cam at an angle as damage to delicate switch contacts could occur.

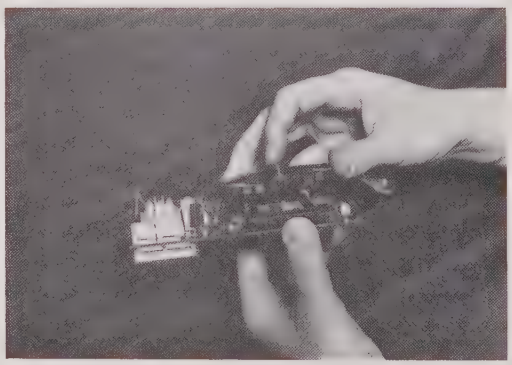
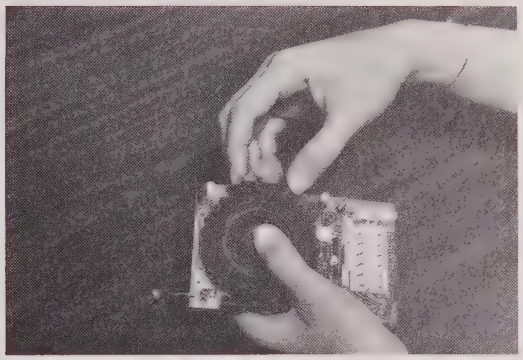
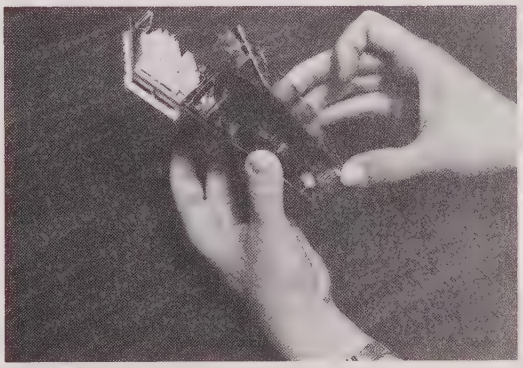


Figure 3-4. Removal, Replacement and Inspection Procedure for Electronics Assembly (continued)

7. Insert detent spring into slot beside cam, with the protrusion facing toward the cam. The detent spring may be mounted on either side.



8. Engage connector on bottom edge of circuit boards, as shown, and gently press the two circuit boards together. Make sure that hub of cam fits into place on the small circuit board, and that the detent spring and two mounting brackets all fit together well.



9. When two circuit boards are back together, insert two screws in front of assembly and tighten. Reassemble entire meter using procedure described in Figure 3-3.

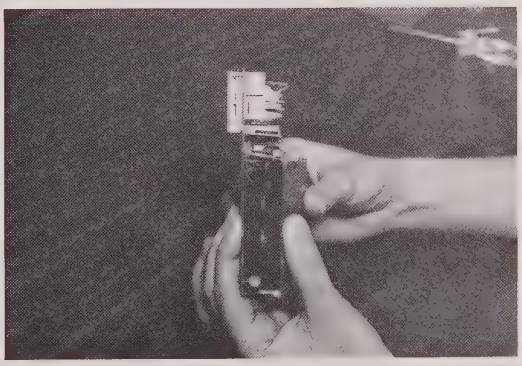


Figure 3-4. Removal, Replacement and Inspection Procedure for Electronics Assembly (continued)

CALIBRATION PROCEDURES

To maintain the accuracy specification of the Multimeter, it is important that the Multimeter be calibrated at least once a year and every time it is repaired. The test equipment necessary to accomplish this procedure is described below:

INSTRUMENT	CHARACTERISTICS	RECOMMENDED MODELS
DC Calibrator	Voltage Range: 0 to 1000 Vdc Accuracy: ±0.025%	Rotek 600 or equivalent
AC Calibrator	Voltage Range: 0 to 110 Vac Frequency Range: 400Hz to 20kHz Accuracy: 0.05% at 400Hz 0.5% at 20kHz	Rotek 600, 745A or equivalent

DC CALIBRATION

1. Perform calibration at ambient temperature of 25 ± 2°C and relative humidity of 80% or less.

> NOTE
> Allow instrument to stabilize at this temperature for at least thirty minutes before proceeding with calibration.

2. Remove back cover from instrument (use procedure described in Figure 3-1).
3. Adjust output of DC calibrator for 190mV ± 0.02% and connect to volt/ohm and COM input connectors on Multimeter.
4. Turn Function/Range Switch on Multimeter to 200mV DCV position.
5. Using small flat-tipped screwdriver, adjust potentiometer R5 (as shown in Figure 3-5) until Multimeter digital display reads +190.0 or +190.1.
6. Disconnect DC calibrator from Multimeter.
7. Replace back cover and secure.

CALIBRATION OF TRUE-RMS MODELS

1. Perform DC calibration as just described.
2. Short Multimeter voltage input terminals.
3. Turn Function/Range Switch to 1000V ACV position.

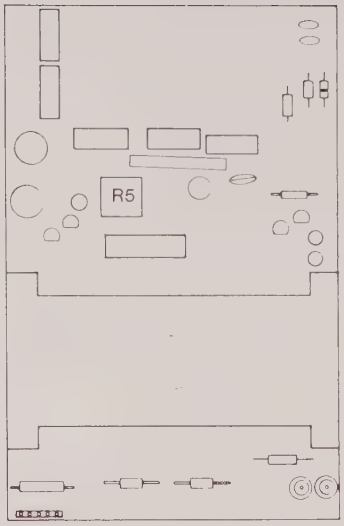


Figure 3-5A.
Large Circuit Board
Non-RMS Models

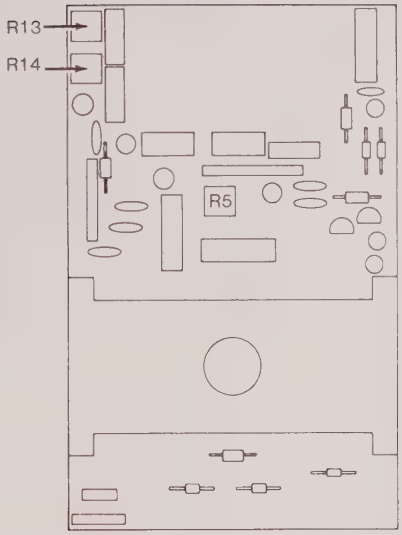


Figure 3-5B.
Large Circuit Board
RMS Models

4. Adjust potentiometer R14 -- the AC zero adjustment (shown in Figure 3-5) until the digital display reads 000 or 001. Make this adjustment very slowly to allow instrument to stabilize.

5. Turn Function/Range Switch to 200mV ACV position.

6. Set output of DC calibrator to 190mV. Connect DC calibrator to V/Ohm and COM inputs on Multimeter (polarity is not important).

7. Adjust potentiometer R13 -- the AC fullscale adjustment (shown in Figure 3-5) until digital display reads 190.0 ± 1 digit.

8. Disconnect DC calibrator from Multimeter.

9. Place Function/Range Switch on Multimeter in 2V ACV position and set AC calibrator for output of 1.900V, 20kHz.

10. Temporarily reinstall back cover of Multimeter.

11. Connect AC calibrator to V/Ohm and COM inputs and note reading. Insure that COM or "low" side terminal of AC calibrator is matched with Multimeter COM input.

12. Remove Multimeter back cover and again note display reading. The difference between the first and second reading is the error voltage.

> NOTE
> At 20kHz, (calibration frequency) 2Vac Multimeter readings tend to be higher with back cover shield removed than with cover attached. Adjust Multimeter to read higher than calibration standard voltage so that with cover attached, desired output is achieved.

13. Adjust trimming capacitor C19 -- high frequency adjust (as shown in Figure 3-6) until the display reads a value equal to 1.900 plus the error voltage.

14. Reinstall Multimeter back cover and secure.

15. Verify that the display reads 1.900 ± 20 digits.

FUSE REPLACEMENT

> WARNING
> To prevent shock hazard, turn off Multimeter and disconnect test leads before replacing fuse.

1. Using your index finger, apply pressure to the "A" input and twist counterclockwise. Remove fuse and replace.

> CAUTION
> To prevent fire, use type AGX 2A/250V fuse only.

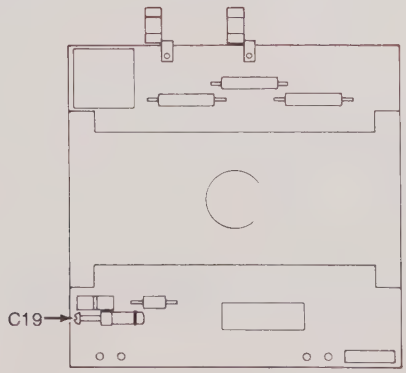


Figure 3-6.
Small Circuit Board
RMS Models

2. For replacing internal fuse, remove three screws and meter cover. Fuse is located on rear of circuit board assembly. Replace with 3A/600V fuse only.

MULTIPROCESSOR CHIP AND
LIQUID CRYSTAL DISPLAY REPLACEMENT

If you have determined that either the multiprocessor chip or the display needs to be replaced, this can be accomplished by following the procedure in Figure 3-7.

ELASTOMER STRIPS CLEANING
AND REPLACEMENT PROCEDURE

If display segments do not function or if the troubleshooting guide instructs you to inspect or replace an elastomer strip, access to these connectors can be gained by following the procedure in Figure 3-7. Strips can be cleaned by dusting with a short bristle camel's hair brush. If grease or fingerprint contamination is suspected, the strip may be washed in clean alcohol and air-dried. Do not wipe with fibrous material as excessive lint can cause poor connections.

SERVICE PROCEDURES FOR BENCH/PORTABLE METERS

BATTERY REPLACEMENT

> WARNING
> To prevent electrical shock hazard, turn off Multimeter and disconnect test leads before removing cover.

1. After turning off Multimeter and removing test leads, remove cover by opening accessory compartment and extracting three screws.

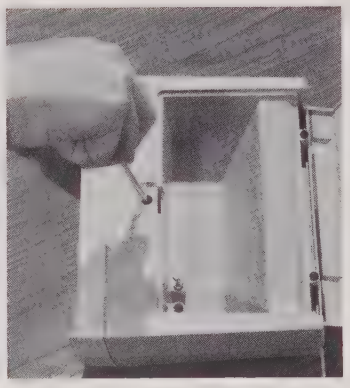
> CAUTION
> Failure to turn off instrument before installing batteries could result in damage to batteries if they are connected incorrectly to terminals.

2. Disconnect batteries from instrument and replace with six new heavy duty (zinc-chloride) D size batteries.

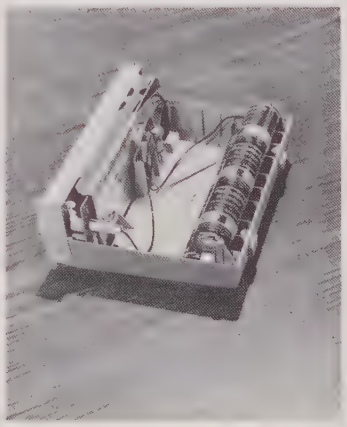
3. Replace cover and secure with three screws.

> WARNING
> Do not operate multimeter with cover removed (except during calibration).

1. After disconnecting test leads and turning off Multimeter, open accessory compartment lid and remove three exposed screws. Lift up on top rear housing and remove.



2. Remove six D-size batteries and disconnect battery terminal from circuit board.



3. Remove the two screws contained in neoprene washers, then separate the front panel assembly from the bottom rear housing.

Figure 3-7. Procedure for Disassembly and Repair of Bench Meters

4. Using your index finger, apply pressure to the "A" input on the front panel and twist counter-clockwise. Remove fuse and holder.

5. Remove three screws from rear of circuit board assembly.

6. Slightly separate electronics assembly from front panel.

Figure 3-7. Procedure for Disassembly and Repair of Bench Meters (continued)

7. Remove current input wire from "A" input terminal by sliding the end of the wire forward.

8. Carefully remove foil shield from around electronics assembly.

CAUTION

Circuit boards are static sensitive. Handle by edges to avoid causing damage.

9. Remove two screws from front of electronics assembly.

Figure 3-7. Procedure for Disassembly and Repair of Bench Meters (continued)

10. Using needle nose pliers, gently unplug the three ribbon connectors from their sockets between the circuit boards.

11. Remove two spacers from between circuit boards.

12. Grasping circuit boards by their outer edges, gently pull the two boards straight apart.

CAUTION

Damage to the Function/ Range Switch may occur if boards are not pulled straight apart.

Figure 3-7. Procedure for Disassembly and Repair of Bench Meters (continued)

13. Disassembly of meter is now complete and inspection or repairs may be made. Procedure for replacement of multiprocessor chip or Liquid Crystal Display is the same as described for hand-held meters. (Reference Figure 3-3, beginning with Step 4.)

Figure 3-7. Procedure for Disassembly and Repair of Bench Meters (continued)

1. Carefully engage cam onto circuit board. Make sure hub of cam fits into mounting hole.

CAUTION

Do not engage cam at an angle as damage to delicate switch contacts could result.

2. Insert detent spring into slot beside cam. Detent spring may be mounted on either side.

3. Reassemble two circuit boards, making sure that cam hub, detent spring, and mounting indexes all fit into place.

4. Install two spacers between circuit board edges.

Figure 3-8. Reassembly of Bench Meters

5. Reconnect three ribbon connectors into their sockets.

6. Replace two screws in front of circuit board assembly.

7. Carefully replace foil shield around circuit board assembly. Be sure flap is tucked between two circuit boards.

Figure 3-8. Reassembly of Bench Meters (continued)

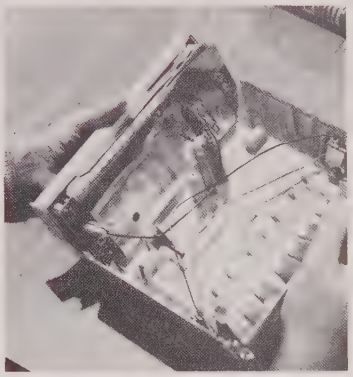
8. Route current input wire through hole in large circuit board, then place terminal end and spring into "A" input terminal. Also replace "A" input fuse and holder.

9. Place circuit board assembly into front panel, making sure that power and beeper switches, all input terminals, and the Function/Range Switch are mechanically aligned. It may be necessary to rotate the Function/Range Switch to align it with the cam hub.

10. Replace three screws in rear of circuit board assembly.

Figure 3-8. Reassembly of Bench Meters (continued)

11. Hinge front panel to bottom rear housing and replace two screws through neoprene washers into circuit board assembly.



12. Replace six batteries, observing proper polarity, then reconnect battery terminal.

13. Replace top rear housing and three screws.

Figure 3-8. Reassembly of Bench Meters (continued)

CALIBRATION PROCEDURE FOR BENCH/PORTABLE METERS

To maintain the accuracy specifications of the Multimeter, it is important that the Multimeter be calibrated at least once a year and every time it is repaired. The test equipment needed to accomplish this procedure is described below:

Instrument Type	Required Characteristics	Recommended Models
dc calibrator	Voltage Range: 0 to 1000Vdc Accuracy: ±0.025%	Rotek 600 or Equivalent
ac calibrator (For use with RMS3060 only)	Voltage Range: 0 to 110Vac Frequency Range: 400Hz to 20kHz Voltage Accuracy: 0.05% at 400Hz; 0.5% at 20kHz	Rotek 600, HP745A, or Equivalent
Thermocouple or Shorting Plug	K-type (chromel-alumel) or Solid copper or aluminum shorting plug	Omega connector SMP-K-M with chromel-alumel wire or equivalent, or Omega connector-SMP-U-M with connector terminals shorted with copper wire or equivalent
Thermometer	0.1°C resolution 0.1°C accuracy	

DC CALIBRATION

1. Perform calibration at an ambient temperature of 25°C ± 2°C and a relative humidity of 80% or less. Allow instrument to stabilize at this temperature for at least thirty minutes.

2. Remove the top rear housing of the instrument by opening the accessory compartment lid and extracting three exposed screws.

3. Set the output of the DC calibrator for 190mV ± 0.02% and connect it to the volt/ohm and COM input connectors.

4. Turn the Function/Range Switch on the Multimeter to the 200mV DCV position.

5. Using a small flat-tipped screwdriver, adjust potentiometer R32 as identified in Figure 3-9 until digital display reads +190.0.

6. Disconnect DC calibrator from Multimeter.

7. Replace rear housing and secure with three screws.

AC CALIBRATION

1. Perform DC calibration as just described.

2. Short the voltage input terminals.

3. Turn Function/Range Switch to the 1000V ACV position.

4. Adjust potentiometer R16, as identified in Figure 3-10, until the digital display reads 000 or 001. Make this adjustment very slowly and allow the instrument to stabilize.

5. Turn Function/Range Switch to the 200mV ACV position. Place AC/DC switch in the AC + DC position.

6. Set the output of the DC calibrator to 190mV. Connect the DC calibrator to the volt/ohm and COM input connectors (polarity is not important).

7. Adjust potentiometer R24, as identified in Figure 3-10 until the digital display reads 190.0 ± 1 digit.

8. Disconnect DC calibrator.

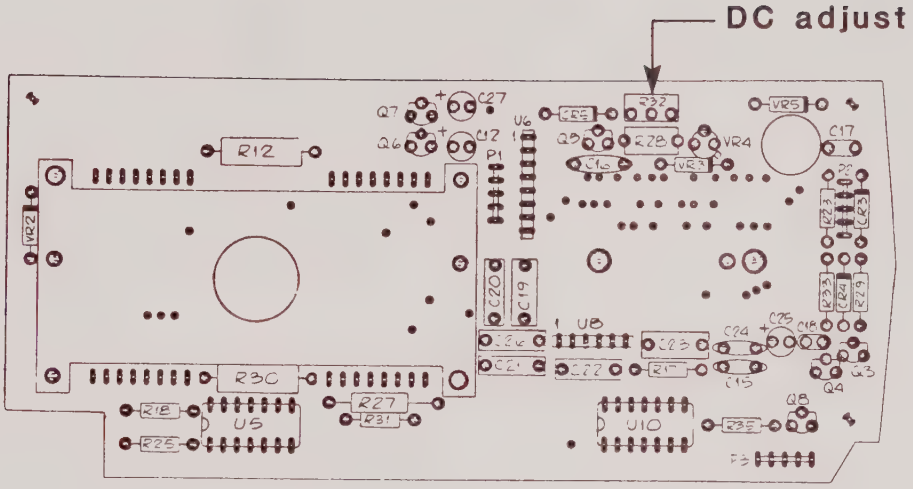
9. Place Function/Range switch in the 2V ACV position and set the AC calibrator for an output of 1.900V, 20kHz.

10. Adjust trimming capacitor C5, as identified in Figure 3-10, until digital display reads 190.0 ± 0.001.

11. Replace Multimeter top rear housing and secure with three screws.

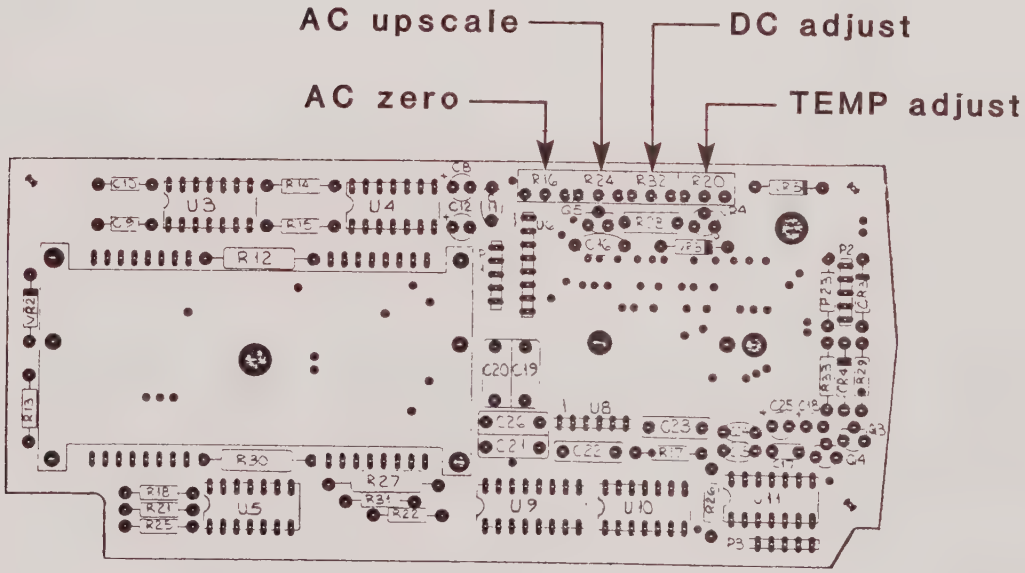
12. Verify that the digital display reads 1.900 ± 20 digits.

13. Disconnect AC calibrator.



DISPLAY BOARD

Figure 3-9. Components Locator for TECH 350, MODEL 3050



DISPLAY BOARD

Figure 3-10. Components Locator for TECH 360, MODEL 3060

TEMPERATURE CALIBRATION

1. Turn Function/Range switch to °C position. Either of two methods may be used: thermocouple or shorting plug. If thermocouple is used, meter is calibrated only for the particular thermocouple used and some error may be involved when another thermocouple is used. Shorting plug calibration involves instrument only.

> NOTE
> Reference thermometer and the meter under calibration should be calibrated in the same environment.

A. Shorting Plug

1. Remove all connections to meter.

2. Install shorting plug described under "Equipment Required for Calibration".

3. Adjust R20 for reference thermometer reading ±1°C.

4. Remove shorting plug.

B. Thermocouple

1. Remove all connections to meter.

2. Install K-type thermocouple into jack.

3. Place thermometer end into bath solution and allow time to stabilize.

4. Adjust R20 for reference thermometer reading ±1°C.

5. Remove thermocouple.

283-679074

SECTION FOUR
TROUBLESHOOTING

This section contains information for restoring the operating performance of the Beckman Series 300 and 3000 Multimeters. These troubleshooting procedures, along with the specific tests for identifying possible causes of faults, provide the technician with the aids to quickly diagnose and correct malfunctions.

On the following pages are Repair Decision Trees (RTD's) for both the Hand-Held and the Benchtop Multimeters. The problems addressed by the RTD's are those that occur most frequently. As you work with the RTD, you will also need to have in front of you the schematic and switch diagram for the particular meter you are servicing. Switch diagrams for the Hand-Held and Benchtop Multimeters are found on pages 4-2 and 4-3, respectively. Schematic diagrams can be found at the end of Section Four. Each drawing lists the Multimeters to which it pertains. Use care when selecting a drawing and be sure it is correct for the Mutimeter you are servicing.

I
METER IN
2 VDC RANGE
(NO INPUT)

A DISPLAY BLANK

1) CHECK BATTERY VOLTAGE (>8.00V).
2) CHECK BATTERY LEADS FOR CONTINUITY.
3) CHECK SWITCH--*See Note 1.*
4) CHECK CURRENT OF MODULE:
   A) DISCONNECT ONE BATTERY TERMINAL.
   B) PLACE ONE LEAD OF METER INTO DISCONNECTED TERMINAL OF BATTERY AND OTHER LEAD INTO DISCONNECTED BATTERY SNAP TERMINAL.

   CURRENT OF MODULE SHOULD READ FROM "0.230 MA" TO "0.400 MA."

IF CURRENT READING IS

1 OL

2 ±.000 (MODULE NOT IN POSITIO

3 CORRECT

B DISPLAY READS "0.00"

1) CHECK SWITCH--*See Note 1.*
2) CHECK 5-PIN CONNECTORS BETWEEN BOARDS FOR CONTINUITY.
3) IF READING IS "OL" ON ALL RANGES, REPLACE MULTIPROCESSOR CHIP (U4).
4) CHECK RESISTOR NETWORK ATTENUATOR (U1)--*See Note 2.*
5) CHECK REF DIODE (VR1). SHOULD READ "-1.2 VDC ±0.05V."
6) CHECK THIN FILM RESISTOR DIVIDER (U2). SHOULD READ: PINS 6-7, 30KΩ
   PINS 5-6, 132KΩ
7) CHECK CAPACITOR (C6)--*See Note 3.*

C DOES NOT ZERO

1) CHECK REF DIODE (VR1). SHOULD READ "-1.2 VDC ±0.05V."
2) CLEAN PC BOARD AREA UNDER SILVER ELASTOMERIC CONNECTORS BETWEEN LARGE PC BOARD AND MULTIPROCESSOR CHIP (U4).
3) REPLACE SILVER ELASTOMERIC CONNECTORS--*See Note 6.*
4) CHECK IF PC BOARDS ARE DIRTY. TURN METER TO "2 VDC," BREATHE ON MODULE NEAR FUSE, AND IF ALL KINDS OF NUMBERS APPEAR, CLEAN BOARD.
5) SHORT CAPACITOR (C4) TO COMMON. IF METER "ZEROES," REPLACE CAPACITOR.

II
METER IN VDC:

1) CALIBRATE WITH 190.0 MV INPUT
2) CHECK WITH 190.0 V INPUT

A READS "000"

1) CHECK SILVER ELASTOMERIC CONNECTORS--*See Note 6.*
2) CHECK SWITCHES--*See Note 1.*
3) CHECK SPARK GAP (SG1) TO SEE IF IT IS SHORTED.
4) CHECK 10-PIN SIP RESISTOR NETWORK (U3).
5) REPLACE MULTIPROCESSOR CHIP (U4).

B READING UNSTABLE

1) CHECK SWITCHES--*See Note 1.*
2) CHECK RESISTOR NETWORK ATTENUATOR (U1)--*See Note 2.*
3) CHECK 2KΩ ±5% RESISTOR (R1) FOR OPEN OR SHORT.
4) CHECK CAPACITORS (C7,C10)--*See Note 3.* IF REVERSING INPUT LEADS STABILIZES DISPLAY, REPLACE CAPACITOR (C9).

   CHECK FEED-THROUGH FROM CAPACITOR (C10)
   TO MULTIPROCESSOR CHIP (U4)
   TO CAPACITORS (C6,C7) FOR CONTINUITY.
5) REPLACE SILVER ELASTOMERIC CONNECTORS--*See Note 6.*
6) REPLACE MULTIPROCESSOR CHIP (U4).

C READING INCORRECT

1) CHECK REF DIODE (VR1). SHOULD READ "1.2 VDC ±0.05V."
2) CHECK 10K POT (R5) FOR OPEN OR SHORT.
3) CHECK RESISTOR NETWORK ATTENUATOR (U1)--*See Note 2.*
4) CHECK 2MΩ ±5% RESISTOR (R8).
5) REPLACE MULTIPROCESSOR CHIP (U4).
6) CHECK FOR OPEN TRACE ON SMALL PC BOARD BETWEEN VΩ INPUT TERMINAL PIN AND SOLDER PAD--#1 OF FEMALE 5-PIN CONNECTOR. SHOULD READ APPROX "2KΩ."
7) CHECK SWITCHES--*See Note 1.*
8) CHECK CAPACITOR (C11)--*See Note 3.*

1) CHANGE THE MULTIPROCESSOR CHIP (U4). EVEN IF THIS FIXES PROBLEM, CHECK RESISTOR NETWORK ATTENUATOR (U1)--*See Note 2.*

2) INSPECT SMALL SIGNAL DIODE (CR1) NEAR BATTERY LEADS. DIODE TEST SHOULD READ APPROX "0.6" TO "0.75."

   IF IT READS "OL" BOTH DIRECTIONS, REPLACE DIODE (CR1).

A) IF DIODE (CR1) READS LOW (.050, .000), CHECK CAPACITOR (C1) TO DETERMINE IF IT IS SHORTED. READING SHOULD BE "OL."

B) IF CAPACITOR (C1) IS OKAY, CHECK CAPACITOR (C11) THE SAME WAY.

C) IF CAPACITORS (C1,C11) ARE OKAY, REPLACE SMALL SIGNAL DIODE (CR1).

D) IF CAPACITOR (C1) IS OKAY BUT SOLDER PADS GIVE A SHORTED READING, REMOVE MULTIPROCESSOR CHIP (U4) AND RESET.

E) VISUALLY INSPECT BOARD FOR PC SHORTS.

1) CHECK SWITCH (13B) FOR OPEN.

2) INSPECT HEADGEAR PLASTICS ASSEMBLY FOR PROPER ASSEMBLY.

3) CLEAN PC BOARD UNDER SILVER ELASTOMERIC CONNECTORS BETWEEN LARGE PC BOARD AND MULTIPROCESSOR CHIP (U4).

4) REPLACE SILVER ELASTOMERIC CONNECTORS.

5) CHECK LARGE PC BOARD POWER TRACE FROM "+" SIDE OF BATTERY PAD TO CHIP PAD #21--*See Note 4.*

1) CHECK THAT LCD IS INSTALLED CORRECTLY.

2) CLEAN PC BOARD UNDER CARBON ELASTOMERIC CONNECTOR BETWEEN LARGE PC BOARD AND LCD DISPLAY.

*NOTE 1 - CHECK SWITCHES: *USING THE DIAGRAM, IT SHOWS WHICH SWITCH IS SUPPOSED TO BE OPEN OR CLOSED ON EVERY RANGE. THE SWITCHES ON SMALL BOARD ARE 1A TO 16A; ON BIG BOARD, 1B TO 16B. NUMBERING STARTS FROM CENTER; ODD ON ONE SIDE, EVEN ON OTHER.*

*NOTE 2 - CHECK ATTENUATOR RANGES: *THE MODULE ON 1500 VDC RANGE WITH BATTERY DISCONNECTED SHOULD READ:*

BETWEEN PINS	1-14	19.8MΩ
PINS	1-4	1.98MΩ
PINS	4-5	198KΩ
PINS	5-6	19.8KΩ
PINS	6-7	1.98KΩ
PINS	7-8	220Ω
PINS	9-10	90Ω
PINS	10-11	900Ω

NOTE 3 - CAPACITORS: ON 20MΩ RANGE, OHM SIGN SHOULD APPEAR AND "OL" SHOULD APPEAR (CAPACITOR >.01 μF).

NOTE 4 - CHIP PAD #21: THE TENTH PAD, GOING FROM RIGHT TO LEFT.

NOTE 5 - CAUTION ON HANDLING CHIP.

NOTE 6 - SILVER ELASTOMERIC CONNECTORS: CLEAN WITH RUBBER ERASER. MAKE SURE RESIDUE OF RUBBER IS REMOVED WITH KIMWIPE (OR EQUIVALENT).

*CONNECTORS

BETWEEN BOARDS, AND NUMBERING FROM THE EDGE, ARE PINS 1 TO 5 (DESIGNATED "1" ON THE SHEMATIC):

P4 (FOURTH FROM EDGE) IS COMMON.

P2 AND P3 SHOULD READ ".400V" AND WORK ONLY ON OHM RANGES AND DIODE TEST.

P1 IS VOLTS.

P5 IS CURRENT.

REPAIR DECISION TREE

V. TOLAN, Sept. 1981

III ACV AND/OR ACA RANGES NOT CORRECT

- **A** READS "000"
  1) CHECK TRANSISTORS (Q3,Q4) FOR SHORT.
  2) REPLACE MULTIPROCESSOR CHIP (U4).
  3) CHECK 3.3 µF CAPACITOR (C12) USING 20K RANGE OF METER. IT SHOULD READ APPROX "11.15." IF READING IS "0.00," CLIP ONE LEAD AND RECHECK.
  4) IF CAPACITOR (C12) READS "OL," CHECK FOR SOLDER BRIDGES BETWEEN CAPACITOR (C12) AND SOLDER PADS.
  5) INSPECT TRACE FROM SWITCH '5B TO AC CONVERTER (CHIP PAD #1 OR RMS CHIP PIN #8) AND CHECK IF OPEN.
  6) CHECK THIN FILM REF DIVIDER (U2).
- **B** ACV

IV 1500 VDC 1000 VAC READS "000"

1) CHECK RESISTOR NETWORK ATTENUATOR (U1)--*See Note 2.*
2) CHECK SPARK GAP (SG1)--*WARNING: Disconnect input leads first.* CLIP ONE LEAD OF SPARK GAP. METER SHOULD READ CORRECT VALUE.

V ACA & DCA READINGS NOT CORRECT

- **A** "000"
  1) CHECK FUSE AND FUSE CLIP TO INSURE GOOD CONTACT.
  2) CHECK 2-AMP BRIDGE (BR1). PLACE TEST LEADS ACROSS TWO INPUT PINS. READING SHOULD BE "+1.200."
- **B** "OL"
  1) CHECK RESISTOR NETWORK ATTENUATOR (U1)--*See Note 2.*
  2) IF ACA READS "0.00" AND DCA READS "OL":
     A) INSPECT SWITCH BLOCK FOR BURNS.
     B) CHECK IF 5-PIN CONNECTORS BETWEEN SMALL AND LARGE PC BOARDS ARE PROPERLY JOINED.
- **C** OUT OF TOLERANCE
  1) CHECK RESISTOR NETWORK ATTENUATOR (U1). PINS 9-10 SHOULD RE
     PINS 10-11 SHOULD RE
  2) CHECK RESISTORS: R2 = 9.0 ± 1/4%
     R2 = 0.1 ± 1/4%
     R3 = 0.9 ± 1/4%

VI OHMS READING NOT CORRECT

1) CHECK IF DCV AND ACV RANGES READ CORRECTLY. CHECK TRANSISTORS (Q1,Q2).
2) IF DCV AND ACV RANGES FAIL, ALSO CHECK RESISTOR NETWORK ATTENUATOR (U1)--*See No*
3) CHECK SWITCHES--*See Note 1.*
4) MEASURE VOLTAGE BETWEEN Vα INPUT AND COMMON INPUT TERMINALS OF MODULE. SHOULD RE
   ALSO CHECK VOLTAGE BETWEEN COMMON AND PINS (P2,P3). SHOULD READ APPROX "0.400V."
   IF VOLTAGE IS NOT APPROX "0.400V": CHANGE MULTIPROCESSOR CHIP (U4).
   CHECK 10-PIN SIP RESISTOR NETWORK (U3).
   CHECK TRANSISTOR (Q2) COLLECTOR TO SEE IF IT
   IF SO, CLIP EMITTER LEAD
   SIGNIFICANTLY LOWER, TRA
   CHECK TRANSISTOR (Q1) IN THE SAME MANNER.
5) IF OHM RANGES AND DIODE TEST READ LOW OR "0.00": CHECK ZENER DIODES (VR2,VR3) WI
   CHECK RESISTOR (R10). SHOULD R
6) IF OHMS UNSTABLE OR "OL": CHECK 5-PIN CONNECTORS FOR CONTINUITY.
   CHECK SWITCHES--*See Note 1.*
7) IF DIODE READING IS LOW OR "0.00," CHECK TRANSISTOR (Q1).
8) IF DIODE READING IS HIGH, CHECK 100Ω ±5% RESISTOR (R6).

VII FLASHING DECIMAL

1) CHECK BATTERY VOLTAGE (>8.00V).
2) CHECK MULTIPROCESSOR CHIP (U4; PINS 21,22) FOR CONTINUITY.
3) CHECK SWITCHES--*See Note 1.*
4) REPLACE MULTIPROCESSOR CHIP (U4).
5) REPLACE LCD.
6) REPLACE SILVER ELASTOMERIC CONNECTORS--*See Note 6.*

NSTABLE
1) CHECK SWITCHES--*See Note 1.*
2) CHECK TRANSISTORS (Q1,Q3,Q4).
3) CHECK CAPACITORS (C7,C9) FOR SHORTS

UT OF
OLERANCE
1) CHECK SWITCHES--*See Note 1.*
2) CHECK RESISTOR ATTENUATOR (U1) RAN
3) REPLACE MULTIPROCESSOR CHIP (U4).
4) CHECK THIN FILM REF DIVIDER (U2). BE[illegible] NS 9-10, SHOULD READ "5KΩ."
NS 8-9, SHOULD READ "11.15KΩ."
5) CHECK CAPACITORS (C3,C6) FOR SHORT

:00"
1) CHECK SWITCHES--*See Note 1.*
2) CHECK THIN FILM REF DIVIDER (U2) AND TO [illegible] SIP RESISTOR NETWORK (U3, PINS 5,6).
3) CHECK 2MΩ ±5% RESISTOR (R8)
4) CHECK CAPACITORS (C8,C12) FOR
5) CHECK THIN FILM RESISTOR NETWORK (U[illegible] 2 SHOULD READ "-5.00V ±5%."
6) REPLACE MULTIPROCESSOR CHIP

"OL"
1) CHECK SWITCHES--*See Note 1.*
2) CHECK CALIBRATION (190 MV ON 2
3) CHECK REF DIODE (VR1).
4) CHECK RESISTOR NETWORK ATTENUATOR (U[illegible] *Note 1.*
5) CHECK RESISTORS (R5,R6)
6) CHECK THIN FILM RESISTOR NETWORK (U2) [illegible] 2 SHOULD READ "-5.00V ±5%."
7) CHECK CAPACITOR (C6) FOR SHORTS

90 OHMS.
900 OHMS.

2.

D "0.400V."

S SAME VOLTAGE AS EMITTER.
AND RECHECK. IF READING IS
ISISTOR IS SHORTED.

H PC BOARDS SEPARATED. SHOULD READ "0.700V."
AD ".250" TO ".5."

I METER IN 2 VDC RANGE (NO INPUT)

A DISPLAY BLANK

1) CHECK BATTERY VOLTAGE (>8.00V).
2) CHECK BATTERY LEADS FOR CONTINUITY.
3) CHECK SWITCH ON-OFF.
4) CHECK CURRENT OF MODULE:
   A) DISCONNECT ONE BATTERY TERMINAL.
   B) PLACE ONE LEAD OF METER INTO DISCONNECTED TERMINAL OF BATTERY AND OTHER LEAD INTO DISCONNECTED BATTERY SNAP TERMINAL.
   CURRENT OF MODULE SHOULD READ FROM "0.230 MA" TO "0.400 MA."

IF CURRENT READING IS

- 1 OL
  1) CHA EVE RES Not
  2) INS NEA SHO (F REP
  3) CHE
- 2 ±.000 (MODULE NOT IN OFF POSITION)
  1) CHE FRO ON-
  2) INS FOR
  3) CLE ELA LAR CHI
  4) REF COM
- 3 CORRECT
  1) CHI
  2) CLI CO CO

5) CHECK VOLTAGES AT U1 (BEEPER IC).

B DISPLAY READS "0.00"

1) CHECK SWITCH--*See Note 1.*
2) CHECK FLEX CABLES BETWEEN BOARDS FOR CONTINUITY.
3) IF READING IS "OL" ON ALL RANGES, REPLACE MULTIPROCESSOR CHIP (U7)--*See Note 4.*
4) CHECK RESISTOR NETWORK ATTENUATOR (U2)--*See Note 2.*
5) CHECK REF DIODE (VR4). SHOULD READ "-1.2 VDC ±0.05V."
6) CHECK THIN FILM RESISTOR DIVIDER (U5). SHOULD READ: PINS 6-7, 30KΩ
   PINS 5-6, 132KΩ
7) CHECK CAPACITOR (C26)--*See Note 3.*

C DOES NOT ZERO

1) CHECK REF DIODE (VR4). SHOULD READ "-1.2 VDC ±0.05V."
2) CLEAN PC BOARD AREA UNDER SILVER ELASTOMERIC CONNECTORS BETWEEN LARGE PC BOARD AND MULTIPROCESSOR CHIP (U7).
3) REPLACE SILVER ELASTOMERIC CONNECTORS--*See Note 5.*
4) CHECK IF PC BOARDS ARE DIRTY. TURN METER TO 2 VDC, BREATHE ON MODULE NEAR FUSE, AND IF ALL KINDS OF NUMBERS APPEAR, CLEAN BOARD.
5) SHORT CAPACITOR (C20) TO COMMON. IF METER "ZEROES," REPLACE CAPACITOR.
6) CHECK CAPACITOR (C17) FOR SHORT.

II METER IN VDC:

1) CALIBRATE WITH 190.0 MV INPUT
2) CHECK WITH 190.0 V INPUT

A READS "000"

1) CHECK SILVER ELASTOMERIC CONNECTORS--*See Note 5.*
2) CHECK SWITCHES--*See Note 1.*
3) CHECK 8-PIN SIP RESISTOR NETWORK (U6).
4) REPLACE MULTIPROCESSOR CHIP (U7)--*See Note 4.*

B READING UNSTABLE

1) CHECK SWITCHES--*See Note 1.*
2) CHECK RESISTOR NETWORK ATTENUATOR (U2)--*See Note 2.*
3) CHECK 2KΩ ±5% RESISTOR (R1) FOR OPEN OR SHORT.
4) CHECK CAPACITORS (C21,C24,C19)--*See Note 3.* IF REVERSING INPUT LEADS STABILIZES DISPLAY, REPLACE CAPACITOR (C23).
   CHECK FEED-THROUGH FROM CAPACITOR (C24)
   TO MULTIPROCESSOR CHIP (U7)
   TO CAPACITORS (C26,C21) FOR CONTINUITY.
5) REPLACE SILVER ELASTOMERIC CONNECTORS--*See Note 5.*
6) REPLACE MULTIPROCESSOR CHIP (U7)--*See Note 4.*

C READING INCORRECT

1) CHECK REF DIODE (VR4). SHOULD READ "1.2 VDC ±0.05V."
2) CHECK 10K POT (R32) FOR OPEN OR SHORT.
3) CHECK RESISTOR NETWORK ATTENUATOR (U2)--*See Note 2.*
4) CHECK 2MΩ ±5% RESISTOR (R30).
5) REPLACE MULTIPROCESSOR CHIP (U7)--*See Note 4.*
6) CHECK SWITCHES--*See Note 1.*
7) CHECK CAPACITOR (C25)--*See Note 3.*
8) CHECK REF DIVIDER (U5; 132K,30K).

BECKMAN INSTR

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GE THE MULTIPROCESSOR CHIP (U7).
IF THIS FIXES PROBLEM, CHECK
STOR NETWORK ATTENUATOR (U2)--See
2.

ECT SMALL SIGNAL DIODE (VR5)
BATTERY LEADS. DIODE TEST
LD READ APPROX "0.6" TO "0.75."
T READS "OL" BOTH DIRECTIONS,
ACE DIODE (CR1).

K CR3,CR4.

K LARGE PC BOARD POWER TRACE
"+" SIDE OF BATTERY PAD TO
F SWITCH.

ECT HEADGEAR PLASTICS ASSEMBLY
ROPER ASSEMBLY.

N PC BOARD UNDER SILVER
OMERIC CONNECTORS BETWEEN
E PC BOARD AND MULTIPROCESSOR
(U7).

ACE SILVER ELASTOMERIC
ECTORS.

K THAT LCD IS INSTALLED CORRECTLY.

N PC BOARD UNDER CARBON ELASTOMERIC
ECTOR BETWEEN LARGE PC BOARD AND
DISPLAY.

A) IF DIODE (VR5) READS LOW (.050, .000), CHECK CAPACITOR (C4) TO DETERMINE IF IT IS SHORTED. READING SHOULD BE "OL."

B) IF CAPACITOR (C4) IS OKAY, CHECK CAPACITOR (C25) THE SAME WAY.

C) IF CAPACITORS (C4,C25) ARE OKAY, REPLACE SMALL SIGNAL DIODE (CR1).

D) IF CAPACITOR (C4) IS OKAY BUT SOLDER PADS GIVE A SHORTED READING, REMOVE MULTIPROCESSOR CHIP (U7) AND RESET.

E) VISUALLY INSPECT BOARD FOR PC SHORTS.

*NOTE 1 - CHECK SWITCHES: USING THE DIAGRAM, IT SHOWS WHICH SWITCH IS SUPPOSED TO BE OPEN OR CLOSED ON EVERY RANGE. THE SWITCHES ON INPUT BOARD ARE 1A TO 16A; ON DISPLAY BOARD, 1B TO 16B. NUMBERING STARTS FROM CENTER; ODD ON ONE SIDE, EVEN ON OTHER.

*NOTE 2 - CHECK ATTENUATOR RANGES: THE MODULE ON 1500 VDC RANGE WITH BATTERY DISCONNECTED SHOULD READ:

BETWEEN PINS	1-14	19.8MΩ
PINS	1-4	1.98MΩ
PINS	4-5	198KΩ
PINS	5-6	19.8KΩ
PINS	6-7	1.98KΩ
PINS	7-8	220Ω
PINS	9-10	90Ω
PINS	10-11	900Ω

NOTE 3 - CAPACITORS: ON 20MΩ RANGE, OHM SIGN SHOULD APPEAR AND "OL" SHOULD APPEAR (CAPACITOR >.01 μF).

NOTE 4 - CAUTION ON HANDLING CHIP.

NOTE 5 - SILVER ELASTOMERIC CONNECTORS: CLEAN WITH RUBBER ERASER. MAKE SURE RESIDUE OF RUBBER IS REMOVED WITH KIMWIPE (OR EQUIVALENT).

*CONNECTORS

J1-4 (FOURTH FROM EDGE) IS COMMON.

J1-3 AND J1-2 SHOULD READ ".400V" AND WORK ONLY ON OHM RANGES AND DIODE TEST.

J1-1 IS VOLTS.

J1-5 IS CURRENT.

J2-1 IS HOLD CIRCUIT.

MENTS, INC. Bench Meters (NON-RMS)

PAIR

CISION

EE

V. TOLAN, Sept. 1981

III ACV AND/OR ACA RANGES NOT CORRECT

- **A** READS "000"
  1) CHECK TRANSISTORS (Q6,Q7) FOR SHORT.
  2) REPLACE MULTIPROCESSOR CHIP (U7)--*See Note 4.*
  3) CHECK 3.3 UF CAPACITOR (C12) USING 20K RANGE OF METER. IT SHOULD READ APPROX "11.15." IF READING IS "0.00," CLIP ONE LEAD AND RECHECK.
  4) IF CAPACITOR (C12) READS "OL," CHECK FOR SOLDER BRIDGES BETWEEN CAPACITOR (C12) AND SOLDER PADS.
  5) CHECK THIN FILM REF DIVIDER (U5).
- **B** ACV
  - 1 UNSTABLE
  - 2 OUT OF TOLERANCE
  - 3 "000"
  - 4 "OL"
  - 5 OHM SIGN ON ACV

IV 1500 VDC 1000 VAC READS "000"

1) CHECK RESISTOR NETWORK ATTENUATOR (U2)--*See Note 2.*
2) CHECK SWITCHES.

V ACA & DCA READINGS NOT CORRECT

- **A** "000"
  1) CHECK FUSE AND FUSE CLIP TO INSURE GOOD CONTACT.
  2) CHECK 2-AMP BRIDGE (BR1). PLACE TEST LEADS ACROSS TWO INPUT PINS. READING SHOULD BE "+1.200."
- **B** "OL"
  1) CHECK RESISTOR NETWORK ATTENUATOR (U2)--*See Note 1.*
  2) IF ACA READS "0.00" AND DCA READS "OL":
     A) INSPECT SWITCH BLOCK FOR BURNS.
     B) CHECK IF FLEX CABLE (J1-5) BETWEEN SMALL AND LARGE PC BOARDS IS PROPERLY JOINED.
- **C** OUT OF TOLERANCE
  1) CHECK RESISTOR NETWORK ATTENUATOR (U2). PINS 9-10 SHOULD READ 90 OHMS. PINS 10-11 SHOULD READ 990 OHMS.
  2) CHECK RESISTORS: R9 = 9.0 ± 1/4%
     R7 = .0875 ± 1/4%
     R8 = 0.9 ± 1/4%

VI OHMS READING NOT CORRECT

1) CHECK IF DCV AND ACV RANGES READ CORRECTLY. CHECK TRANSISTORS (Q3,Q4).
2) IF DCV AND ACV RANGES FAIL, ALSO CHECK RESISTOR NETWORK ATTENUATOR (U2)--*See Note 2.*
3) CHECK SWITCHES--*See Note 1.*
4) MEASURE VOLTAGE BETWEEN VΩ INPUT AND COMMON INPUT TERMINALS OF MODULE. SHOULD READ "0.400V." ALSO CHECK VOLTAGE BETWEEN COMMON AND PINS (J1-3,J1-2). SHOULD READ APPROX "0.400V."
   IF VOLTAGE IS NOT APPROX "0.400V": CHANGE MULTIPROCESSOR CHIP (U7).
   CHECK 8-PIN SIP RESISTOR NETWORK (U6).
   CHECK TRANSISTOR (Q4) COLLECTOR TO SEE IF IT IS SAME VOLTAG
   IF SO, CLIP EMITTER LEAD AND RECHECK.
   SIGNIFICANTLY LOWER, TRANSISTOR IS SH
   CHECK TRANSISTOR (Q3) IN THE SAME MANNER.
5) IF OHM RANGES AND DIODE TEST READ LOW OR "0.00": CHECK ZENER DIODES (VR3,VR5) WITH PC BOARDS S
   CHECK RESISTOR (R28). SHOULD READ ".250" TO
6) IF OHMS UNSTABLE OR "OL": CHECK FLEX CABLE FOR CONTINUITY.
   CHECK SWITCHES--*See Note 1.*
7) IF DIODE READING IS LOW OR "0.00," CHECK TRANSISTOR (Q3).
8) IF DIODE READING IS HIGH, CHECK 120Ω ±5% RESISTOR (R29).
9) IF ON 20Ω RANGE
10) IF BEEPER DOES NOT SOUND ON Ω-RANGE
    - CHECK U1 (PINS 5,6 - 3
      PIN 4 - 6
    - CHECK BEEPER (PLACE A P
      METER IN THE D
      APPLY (+) AND
      THAT METER TO
      LEADS OF THE B
      CHECKED. IF W
      BEEPER WILL BE
    - CHECK CAPACITOR (C1).

VII FLASHING DECIMAL

1) CHECK BATTERY VOLTAGE (>8.00V).
2) CHECK MULTIPROCESSOR CHIP (U7; PINS 21,22) FOR CONTINUITY.
3) CHECK SWITCHES--*See Note 1.*
4) REPLACE MULTIPROCESSOR CHIP (U7)--*See Note 4.*
5) REPLACE LCD.
6) REPLACE SILVER ELASTOMERIC CONNECTORS--*See Note 5.*

1) CHECK SWITCHES--*See Note 1.*
2) CHECK TRANSISTORS (Q3,Q6,Q7).
3) CHECK CAPACITORS (C21,C23) FOR SHORTS.
4) CHECK U7.

1) CHECK SWITCHES--*See Note 1.*
2) CHECK RESISTOR ATTENUATOR (U2) RANGES.
3) REPLACE MULTIPROCESSOR CHIP (U7)--*See Note 4.*
4) CHECK THIN FILM REF DIVIDER (U5). BETWEEN PINS 9-10, SHOULD READ "5KΩ."
PINS 8-9, SHOULD READ "11.15KΩ."
5) CHECK CAPACITORS (C27,C26) FOR SHORTS.

1) CHECK SWITCHES--*See Note 1.*
2) CHECK THIN FILM REF DIVIDER (U5).
) CHECK 2MΩ ±5% RESISTOR (R30).
6) CHECK CAPACITORS (C19,C12) FOR SHORTS.
5) CHECK THIN FILM RESISTOR NETWORK (U5). PIN 2 SHOULD READ "-5.00V ±5%."
6) REPLACE MULTIPROCESSOR CHIP (U7)--*See Note 4.*
7) CHECK NEGATIVE SUPPLY CIRCUIT.

) CHECK SWITCHES--*See Note 1.*
2) CHECK CALIBRATION (190 MV ON 200 MV DC).
3) CHECK REF DIODE (VR4).
4) CHECK RESISTOR NETWORK ATTENUATOR (U2)(RESISTORS R5,R5)--*See Note 1.*
5) CHECK THIN FILM RESISTOR NETWORK (U5). PIN 2 SHOULD READ "-5.00V ±5%."
5) CHECK CAPACITOR (C26) FOR SHORTS.

) CHECK PTC (R28).
2) CHECK SOLDERING AT P7 OF U6

AS EMITTER.
IF READING IS
RTED.

PARATED. SHOULD READ "0.700V."
.5."

DOES NOT ZERO — CHECK POT (R19).
CHECK TRANSISTORS (Q1,Q2).
NO OHM SIGN & NO BEEP — REPLACE U10.

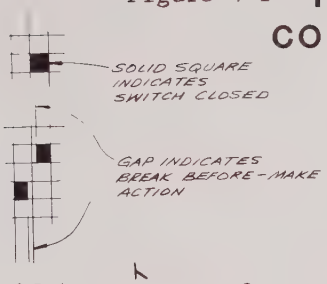
OLTS;
OLTS).

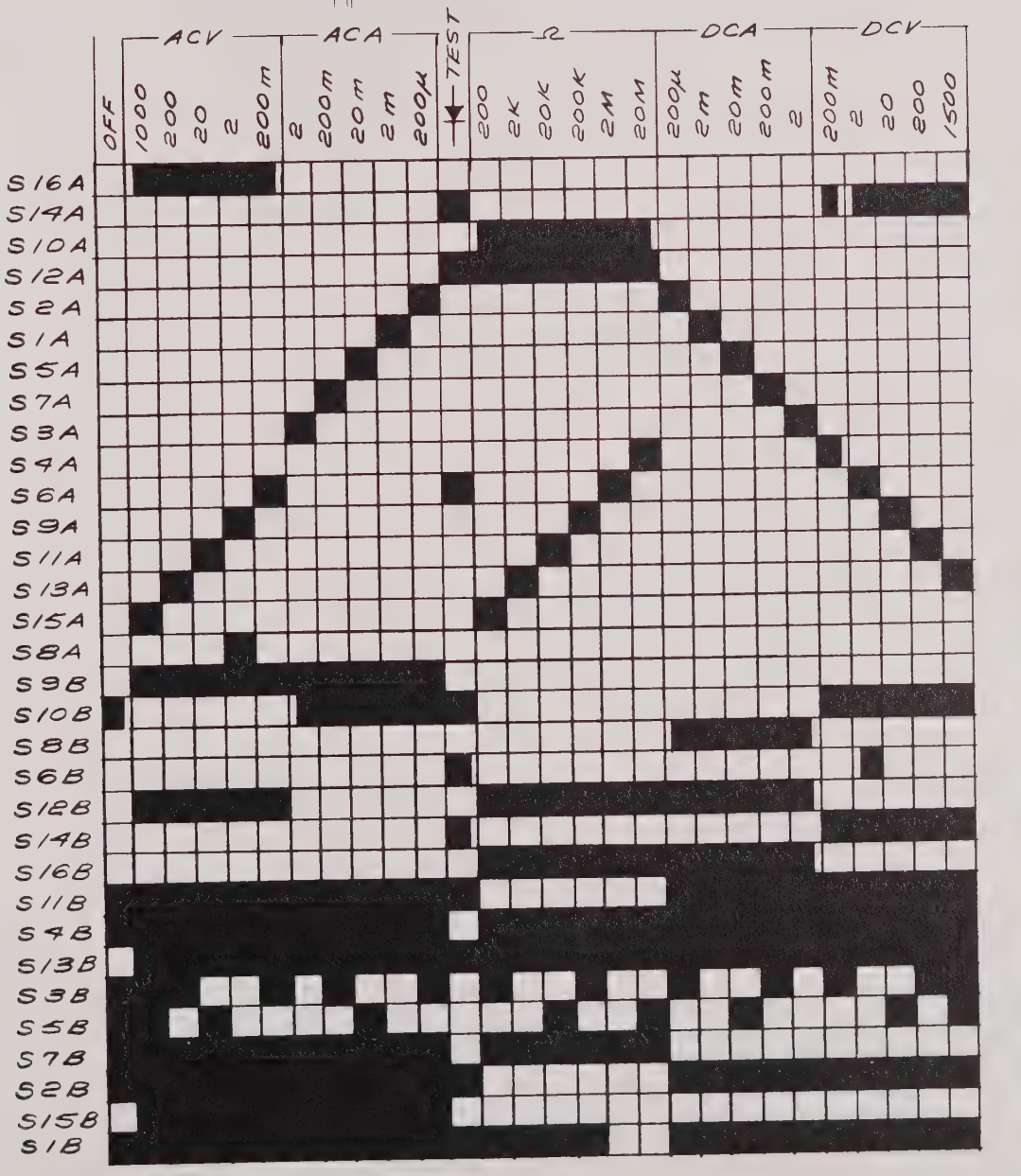
OPERLY WORKING
ODE RANGE AND
-) LEADS OF
HE (+) AND (-)
EPER TO BE
RKING, THE
P).

Figure 4-1 **FUNCTION/RANGE SWITCH CONTACT POSITION MATRIX**

HAND-HELD METERS

S = Switch Contact
A = Input (Small) Board
B = Display (Large) Board

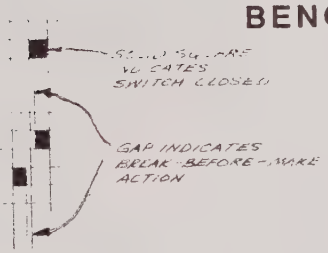


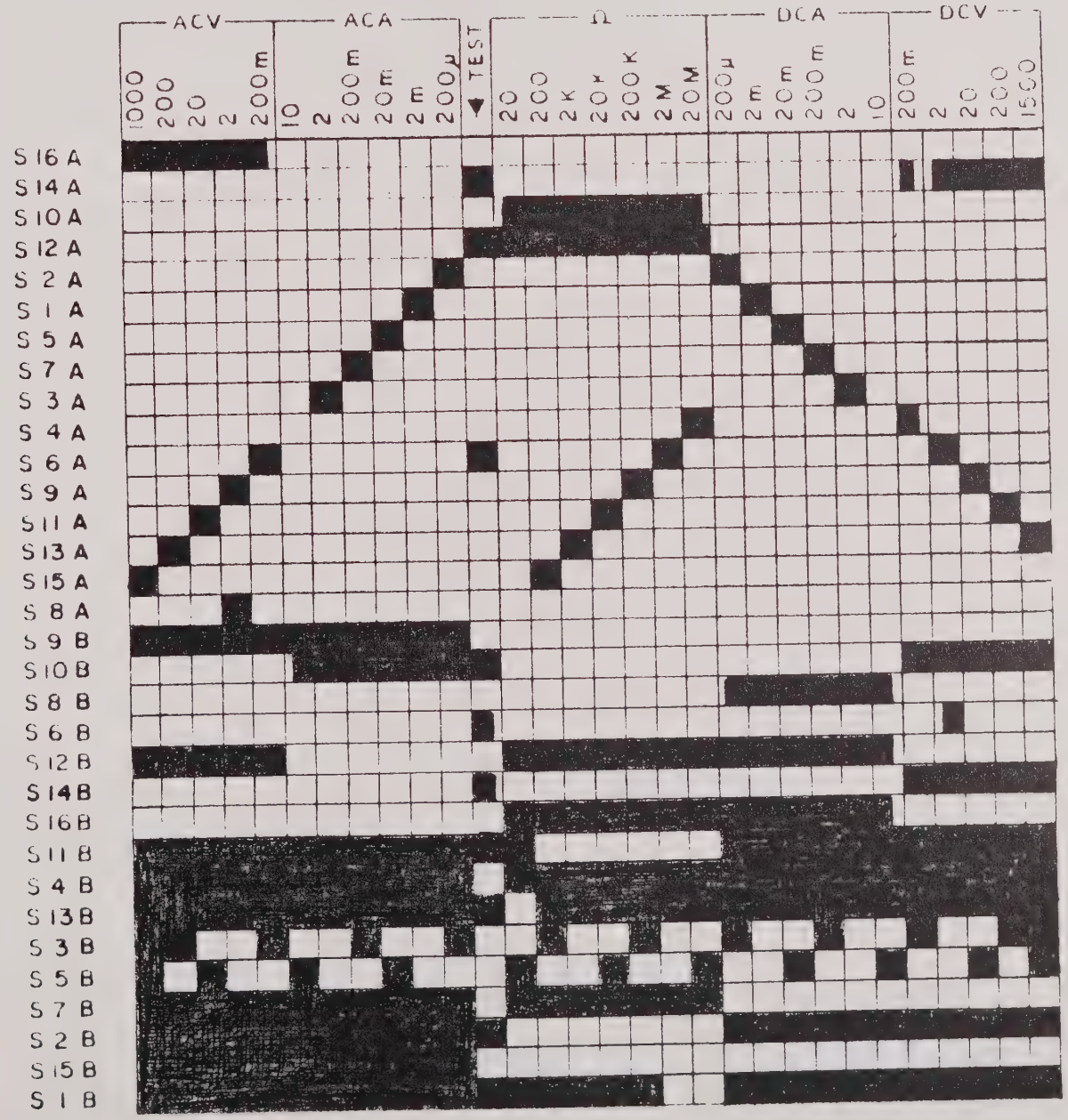


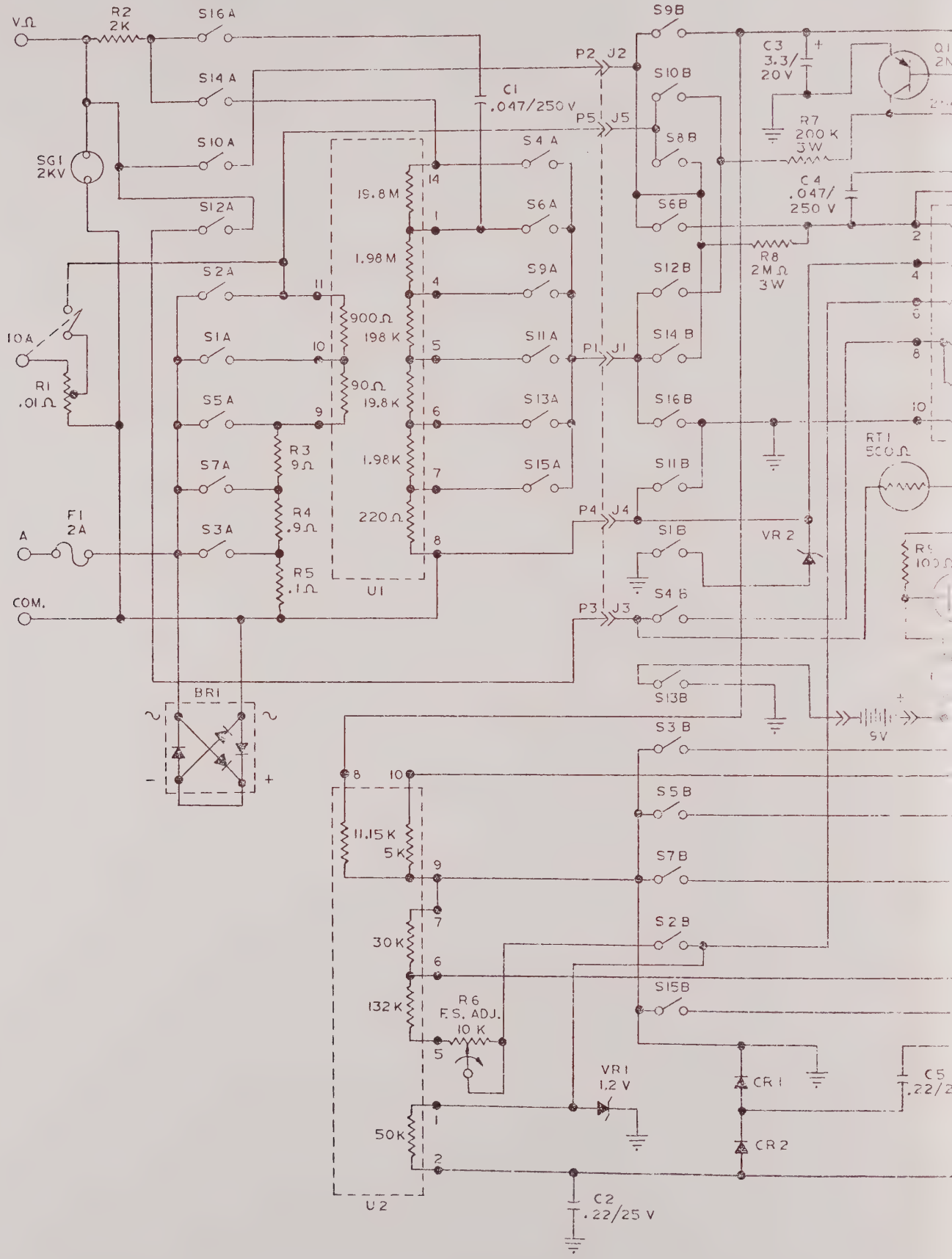
Function/Range Switch Contact Position Matrix

Figure 4-2 **FUNCTION/RANGE SWITCH CONTACT POSITION MATRIX BENCH/PORTABLE METERS**

S = Switch Contact
A = Input (Large) Board
B = Display (Small) Board

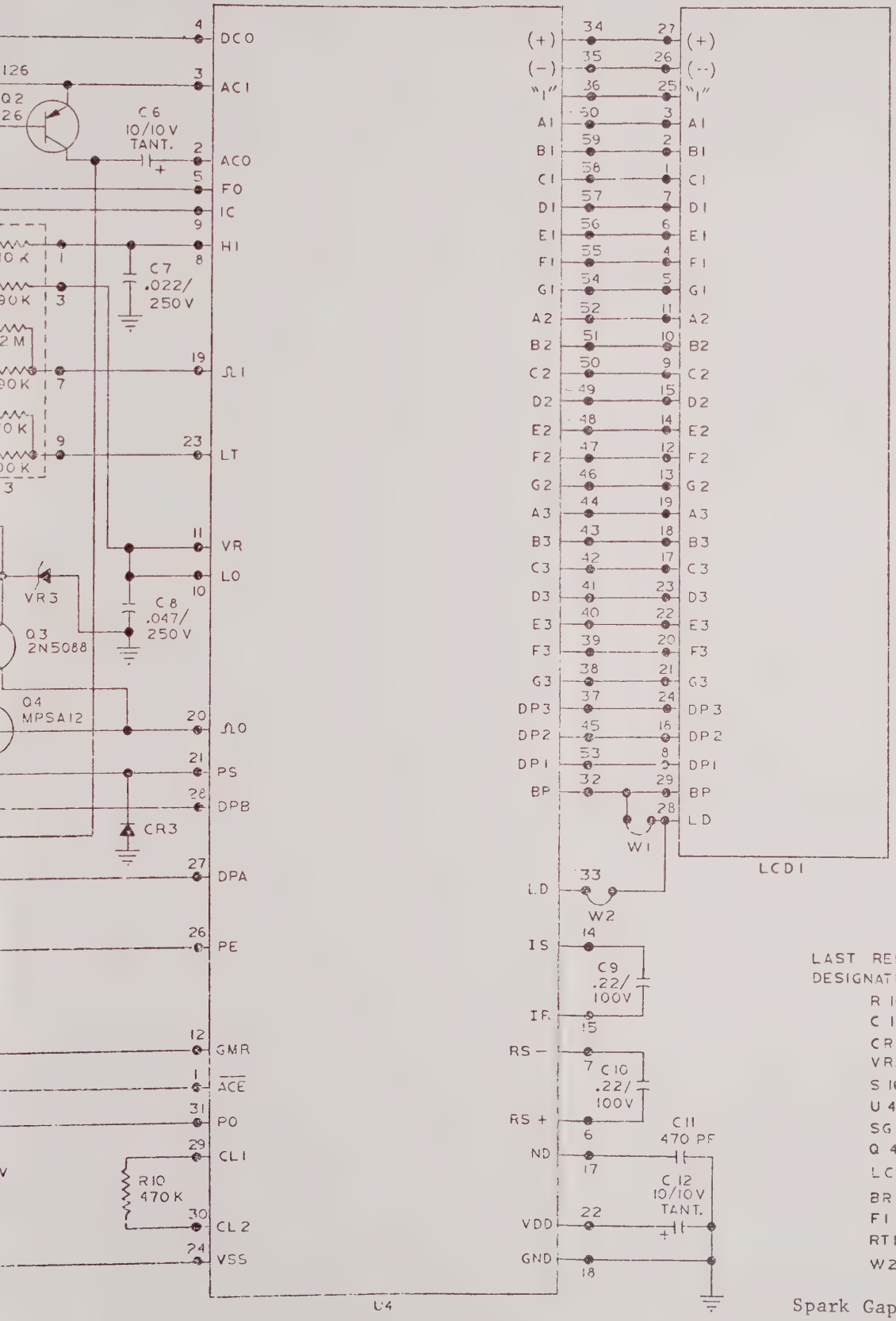






2. RESISTORS ARE IN OHMS.
1. CAPACITORS ARE IN μF.

NOTES: UNLESS OTHERWISE SPECIFIED.



LAST REFERENCE DESIGNATION USED:

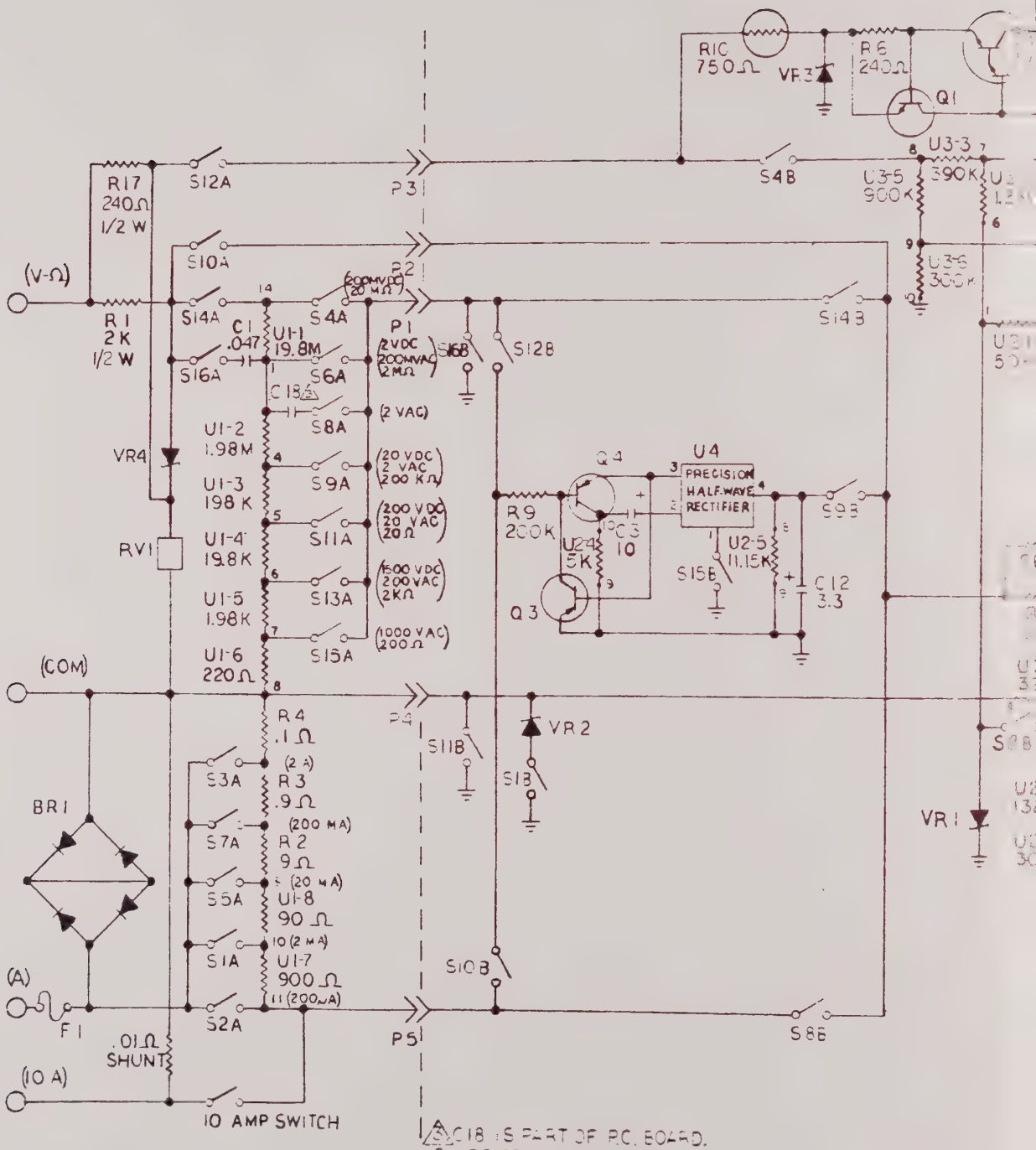
R 10
C 12
CR3
VR3
S 16
U 4
SG 1
Q 4
LCD 1
BR 1
F 1
RT 1
W 2

Spark Gap Models

SCHEMATIC DIAGRAM 3000-510-042 Rev. E

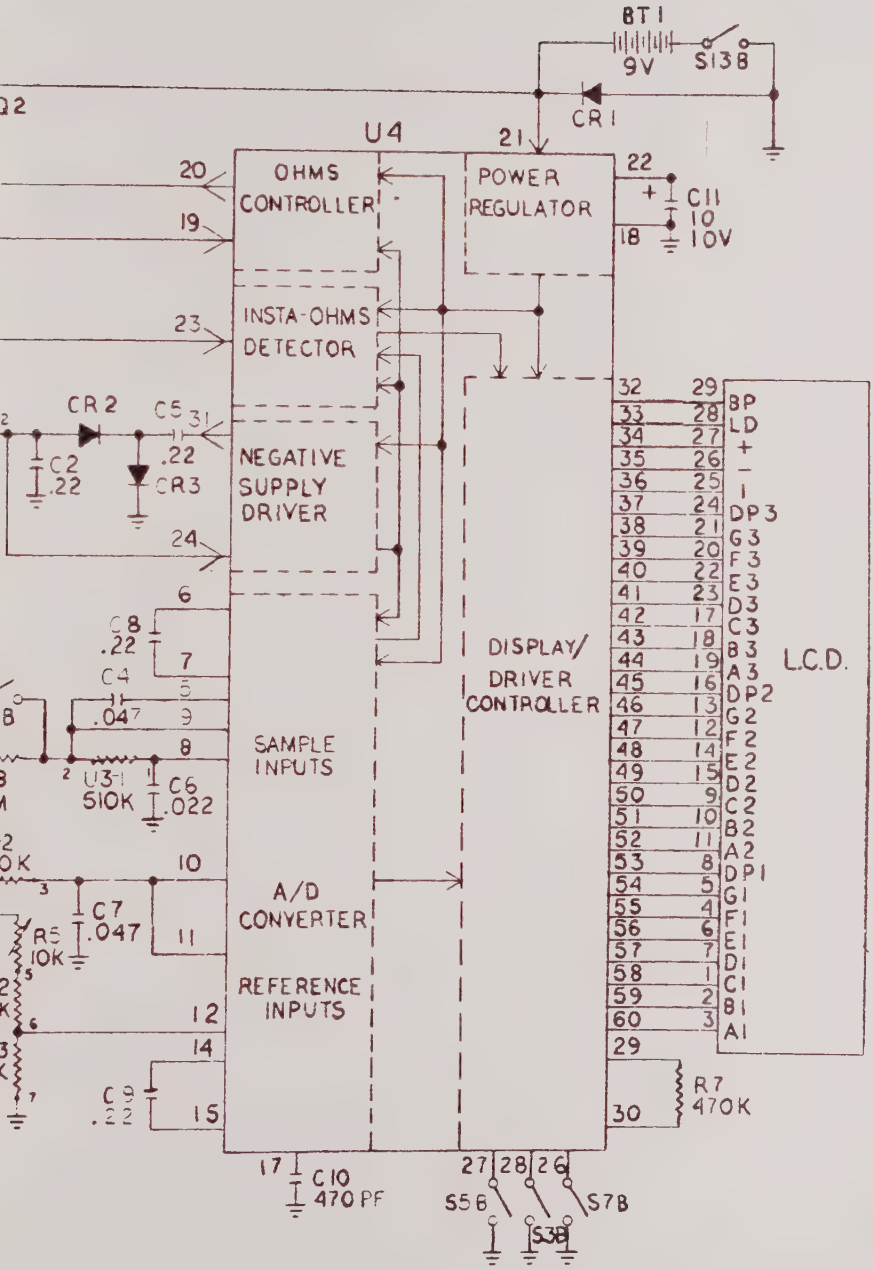
TECH 300, 300-A, 310, 310UL

MODEL 3000, 3010, 3020, MODEL 3010UL



NOTES: UNLESS OTHERWISE SPECIFIED

1. C18 IS PART OF P.C. BOARD.
2. RESISTORS ARE IN OHMS.
3. CAPACITORS ARE IN μF.



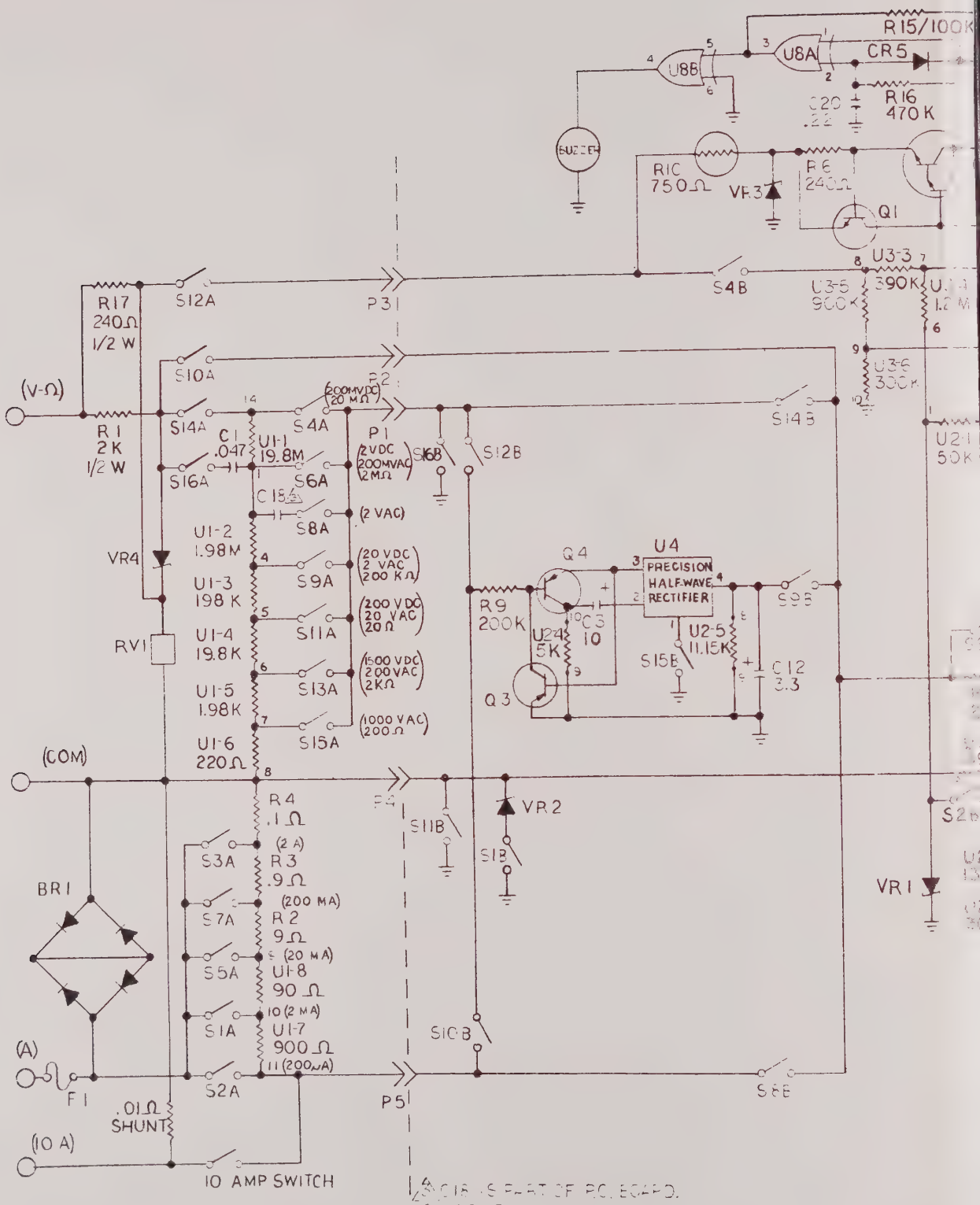
MOV Version of:

TECH 300 TECH 300A MODEL 3000

TECH 310 MODEL 3010

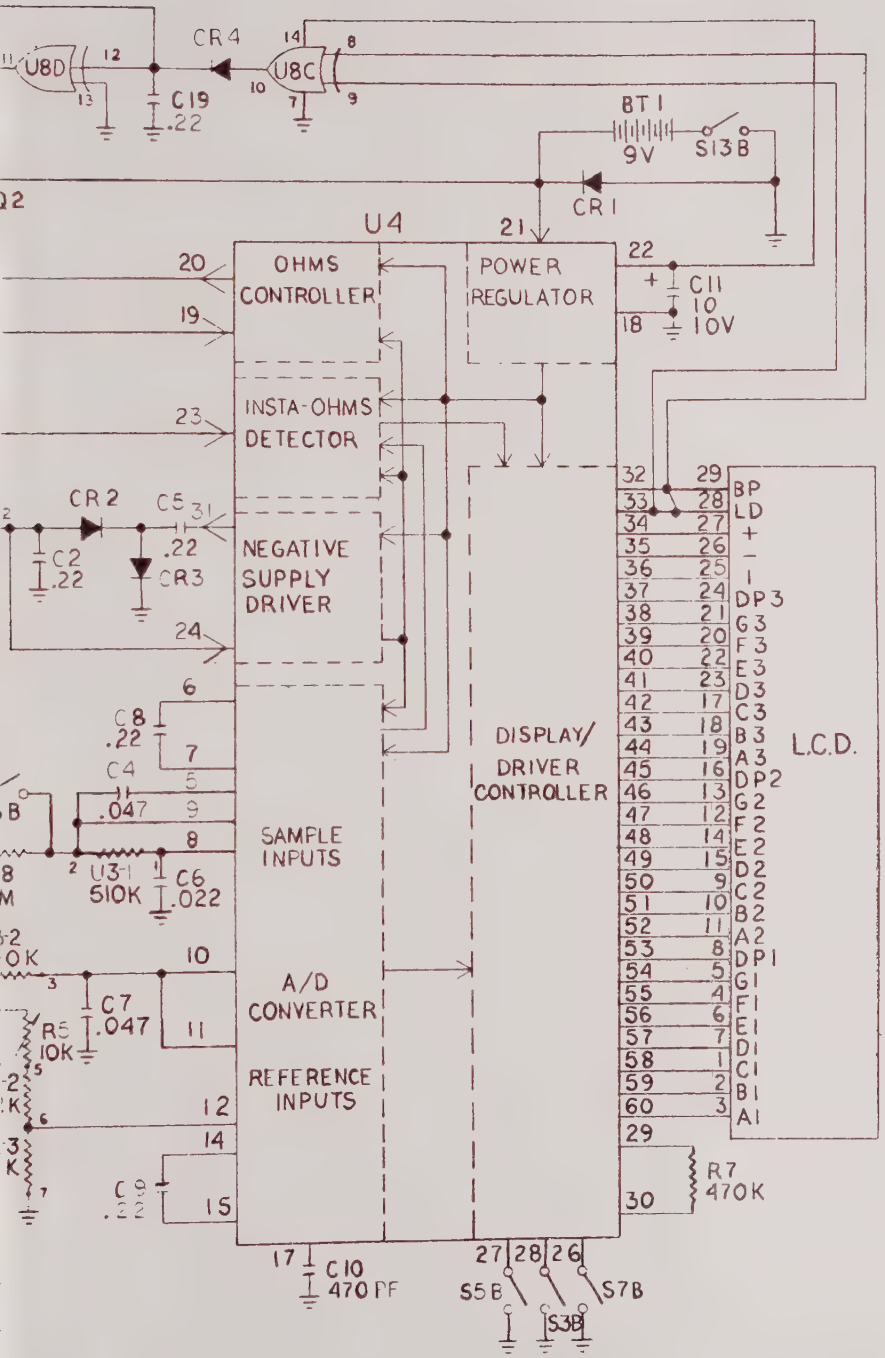
MODEL 3020

TECH 310UL MODEL 3010UL



NOTES UNLESS OTHERWISE SPECIFIED

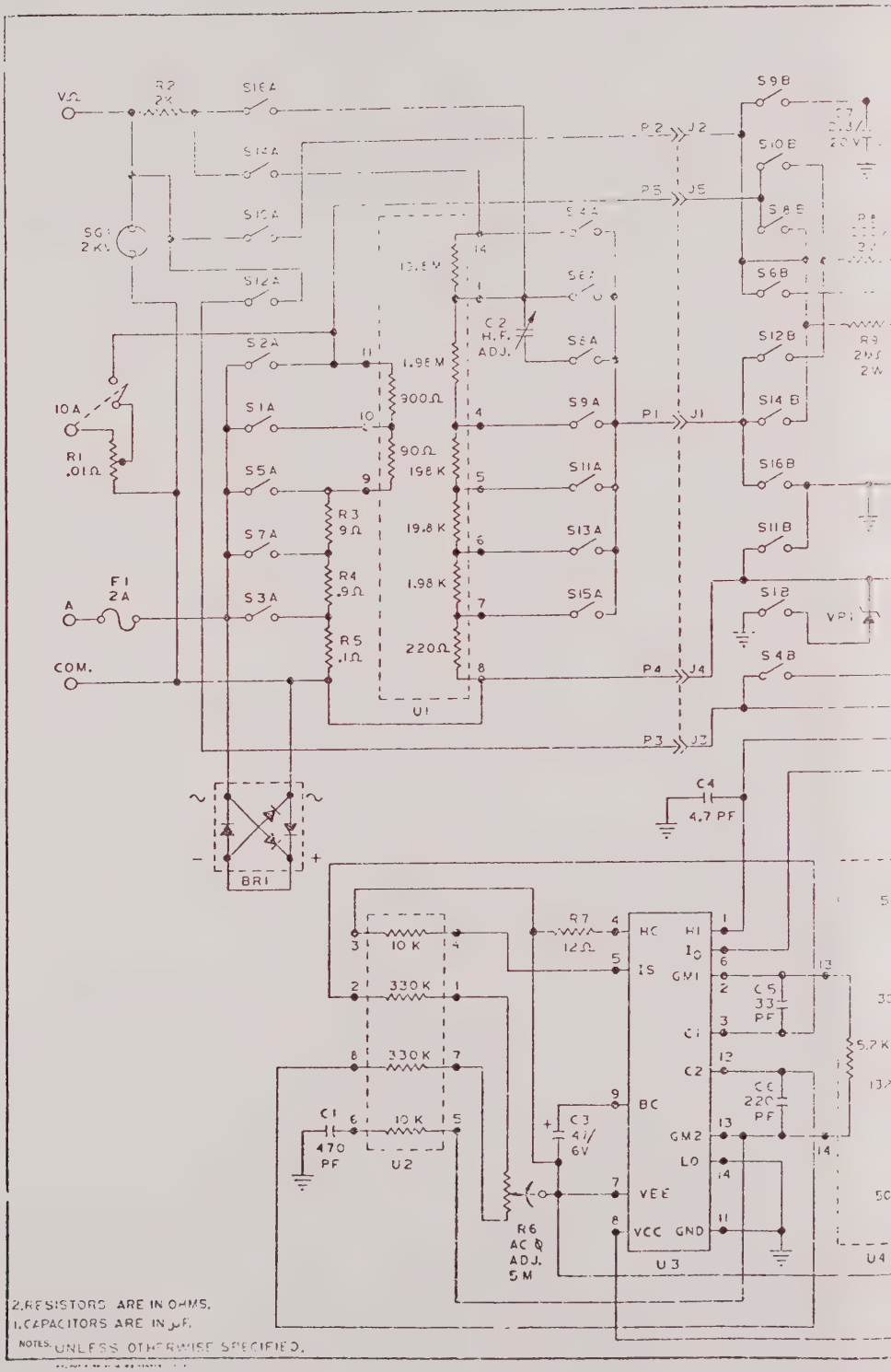
4. SWITCHES ARE PART OF PC BOARD.
2. RESISTORS ARE IN OHMS.
CAPACITORS ARE IN μF.



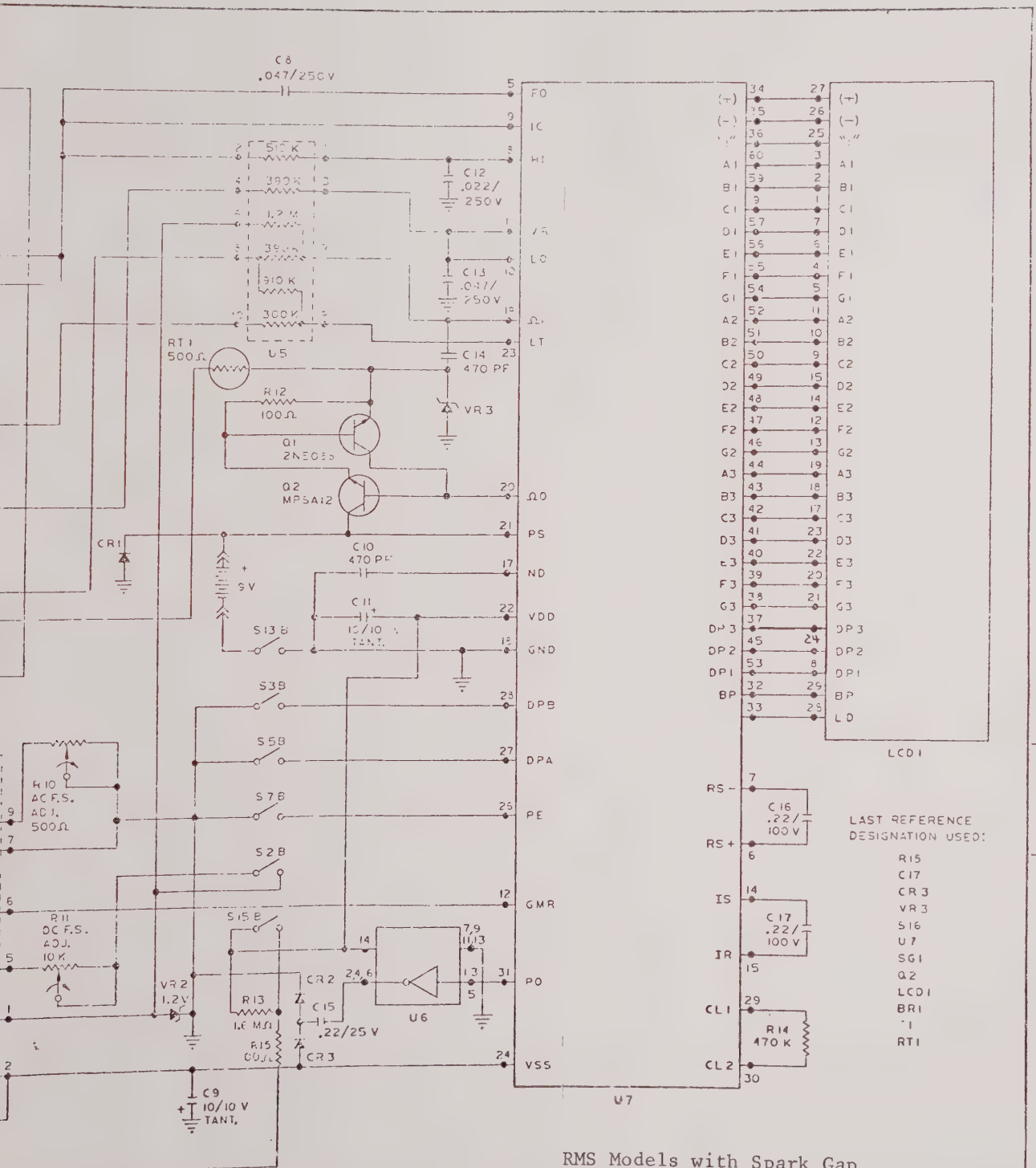
Beeper Models with MOV

SCHEMATIC DIAGRAM 3000-530-105 Rev. B

MODEL 3020-B TECH 320-B



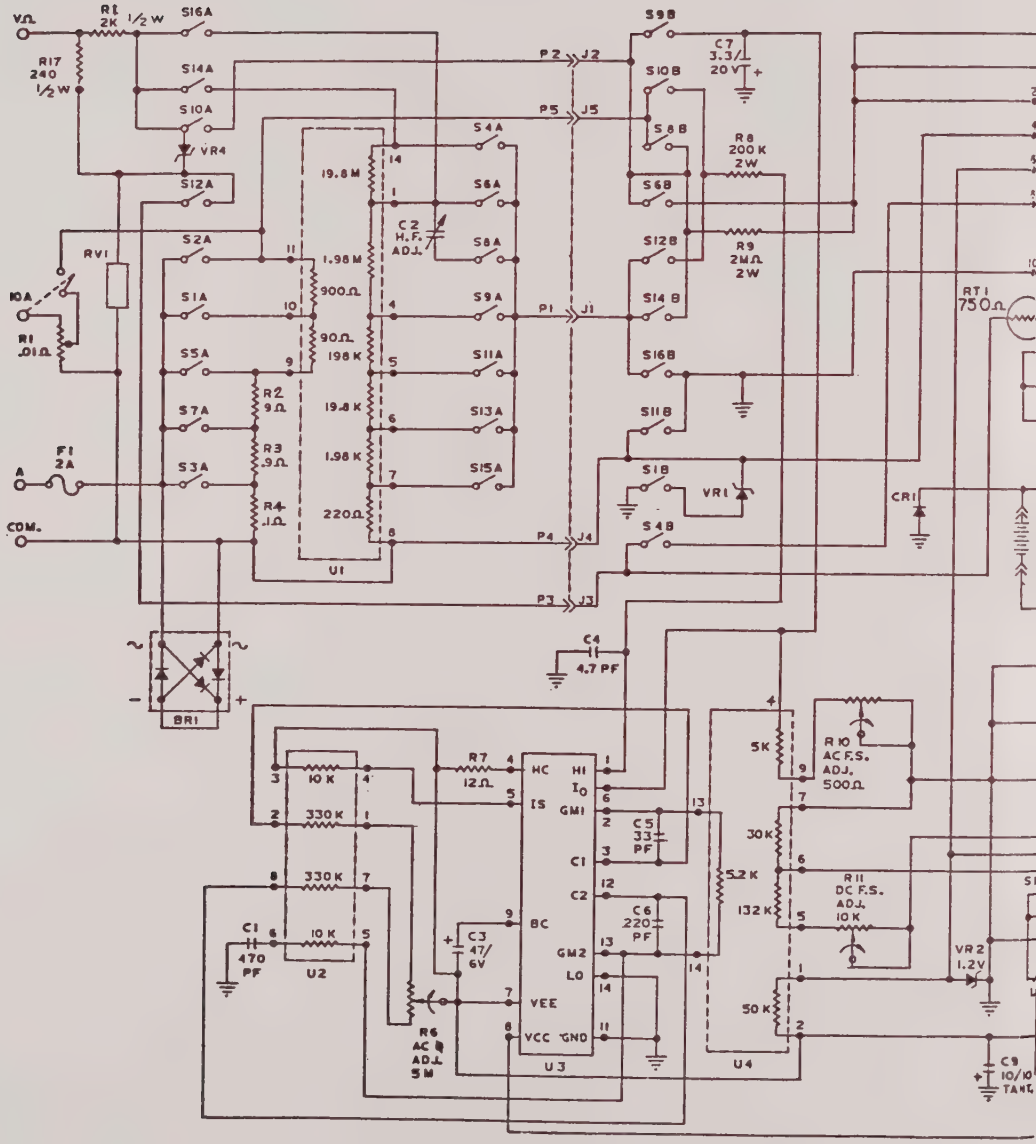
NOTES. UNLESS OTHERWISE SPECIFIED,
1. CAPACITORS ARE IN μF.
2. RESISTORS ARE IN OHMS.

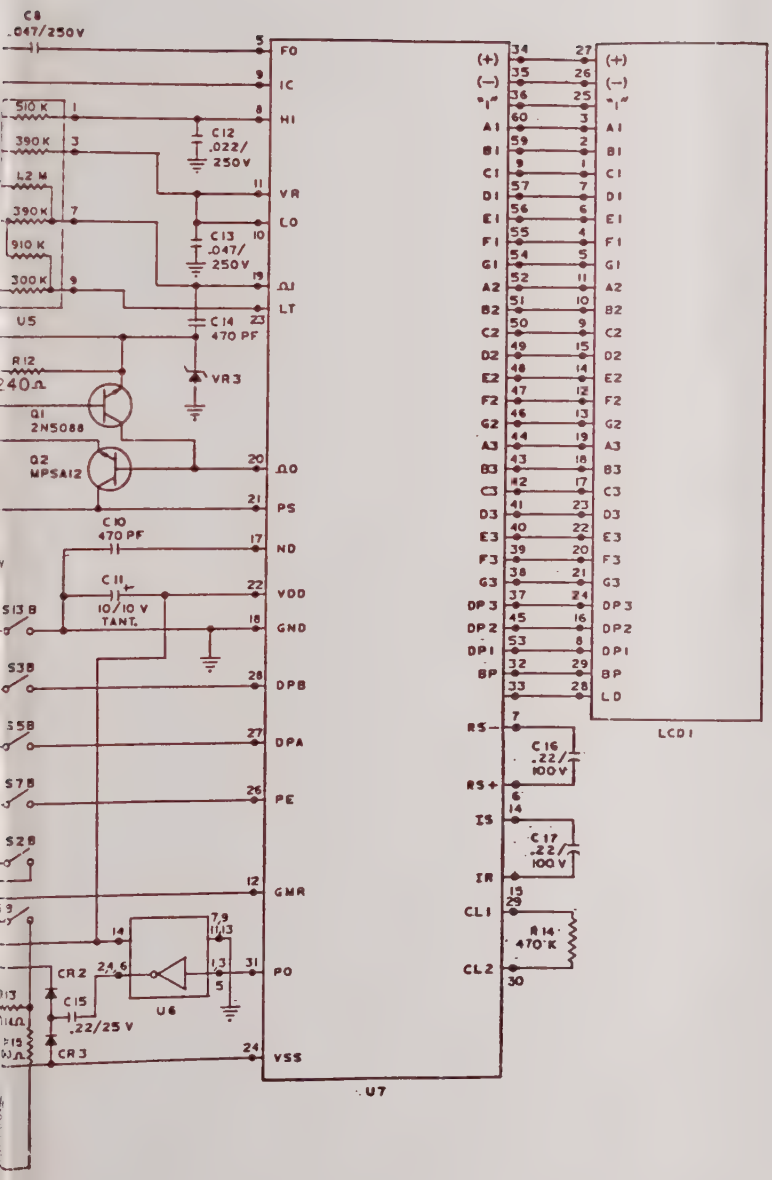


RMS Models with Spark Gap

SCHEMATIC DIAGRAM 3000-530-042 Rev. C

TECH 330, MODEL RMS 3030

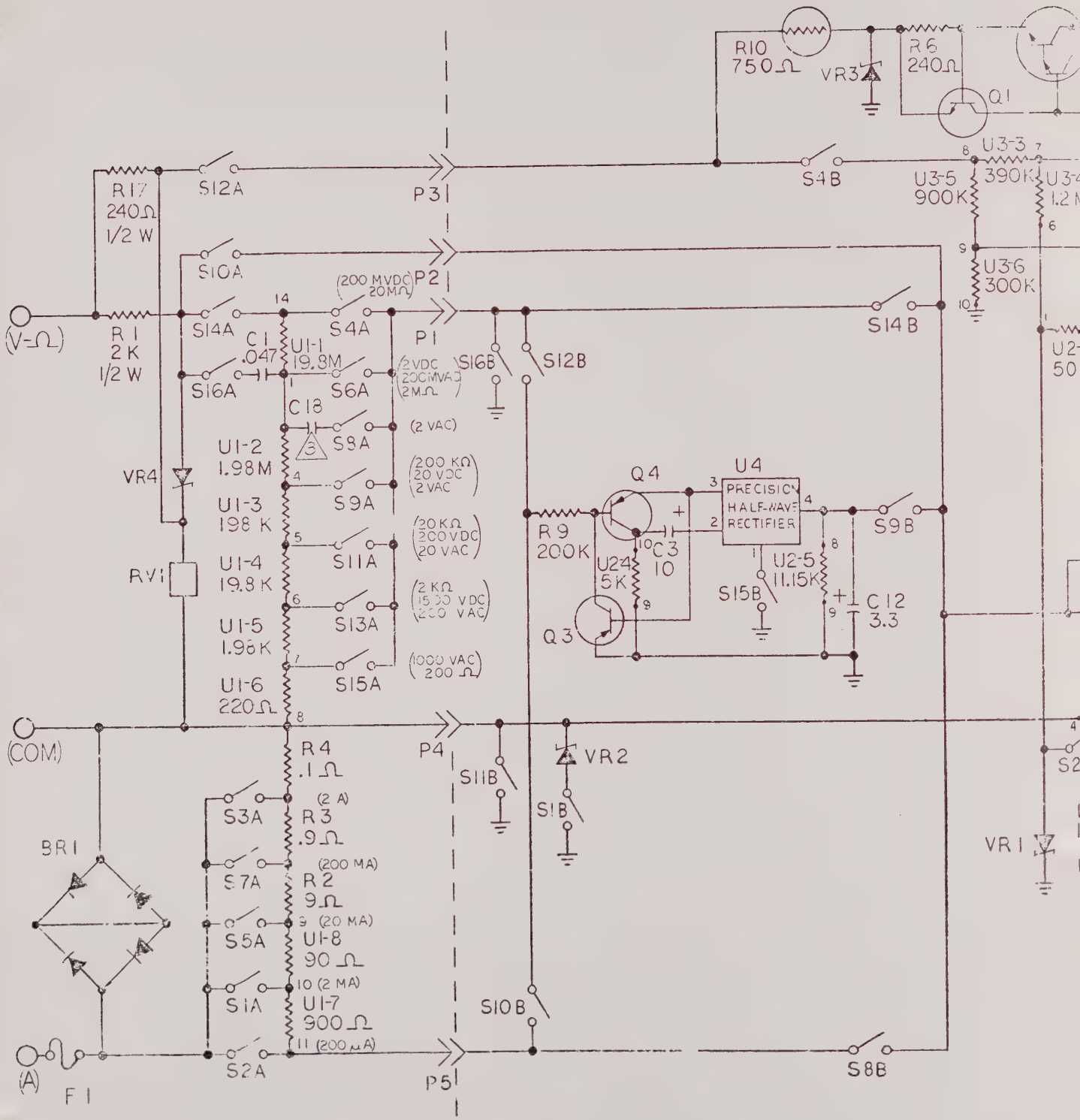

VΩ
A
COM.
F1 2A
10A
RV1
R1 .01Ω
R17 240 1/2W
R1 2K 1/2W
S16A
S14A
S10A
VR4
S12A
S2A
S1A
S5A
S7A
S3A
R2 9Ω
R3 .9Ω
R4 .1Ω
19.8M
1.98M
900Ω
90Ω
198K
19.4K
1.98K
220Ω
U1
C2 H.F. ADJ.
S4A
S6A
S8A
S9A
S11A
S13A
S15A
P2 J2
P5 J5
P1 J1
P4 J4
P3 J3
S9B
S10B
S8B
S6B
S12B
S14B
S16B
S11B
S1B
S4B
C7 3.3/ 20V
R8 200K 2W
R9 2MΩ 2W
RT1 750Ω
VR1
CR1
BR1
C4 4.7 PF
R7 12Ω
10K
330K
330K
10K
C1 470 PF
U2
C3 47/ 6V
R6 AC ADJ. SM
HC
IS
BC
VEE
VCC
HI
IO
GMI
C1
C2
GM2
LO
GND
C5 33 PF
C6 220 PF
U3
5K
30K
132K
5.2K
50K
U4
R10 AC F.S. ADJ. 500Ω
R11 DC F.S. ADJ. 10K
VR2 1.2V
C9 10/10 TANT.



Schematic Diagram

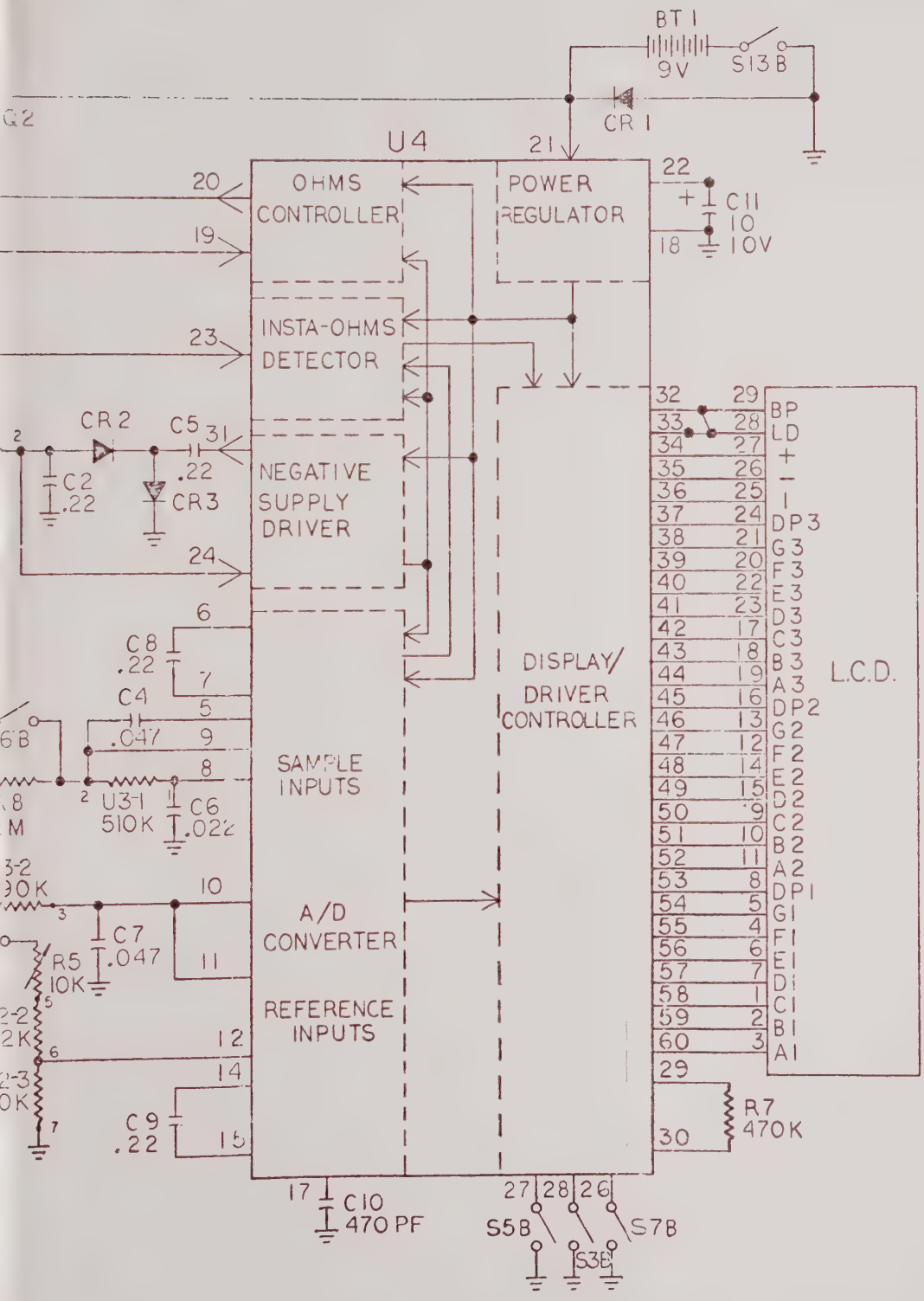
MOV Version of

TECH 330 MODEL RMS 3030



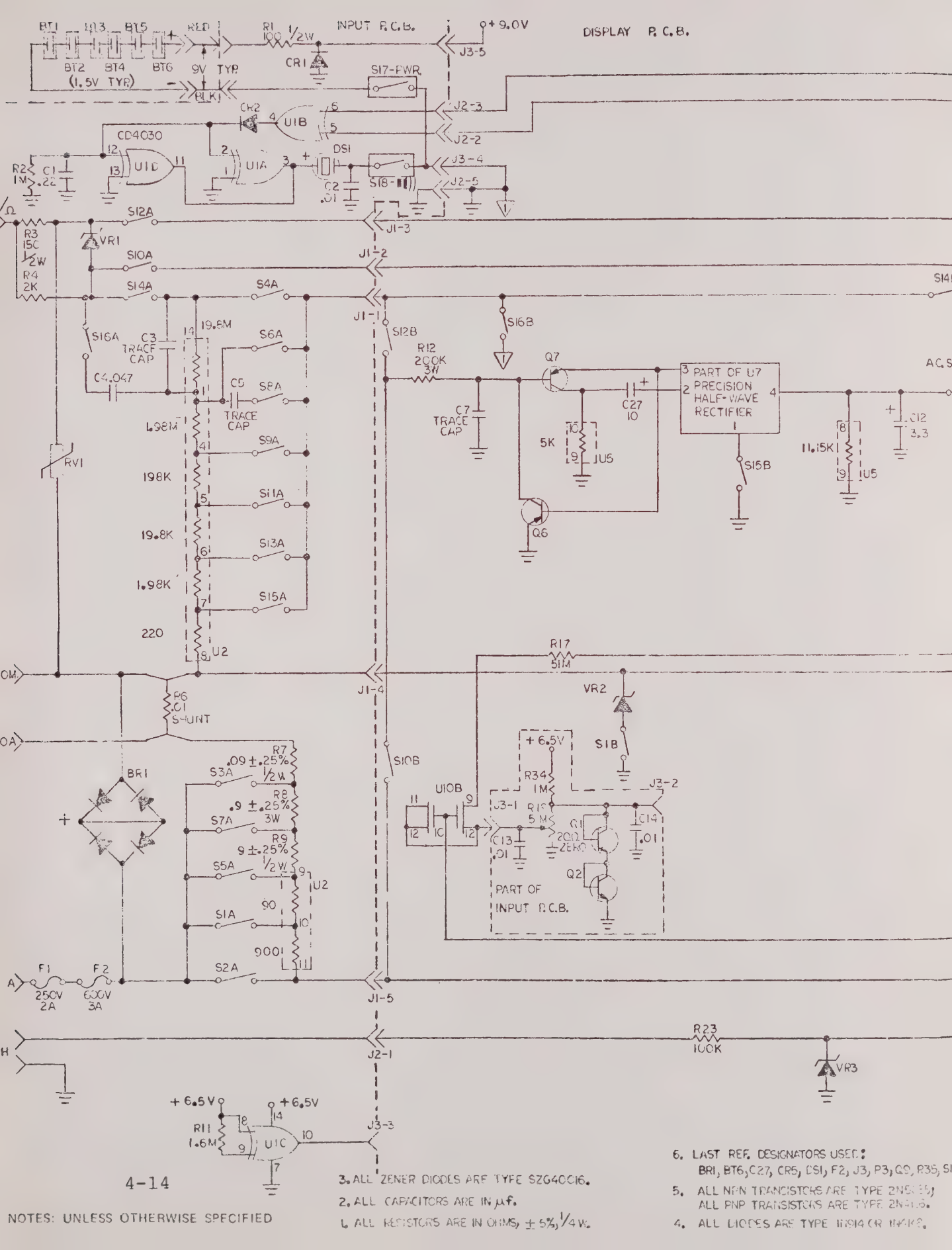
3 C18 IS PART OF P.C. BOARD.
2 RESISTORS ARE IN OHMS.
1. CAPACITORS ARE IN μF.

NOTES: UNL[illegible] OTHERWISE SPECIFIED



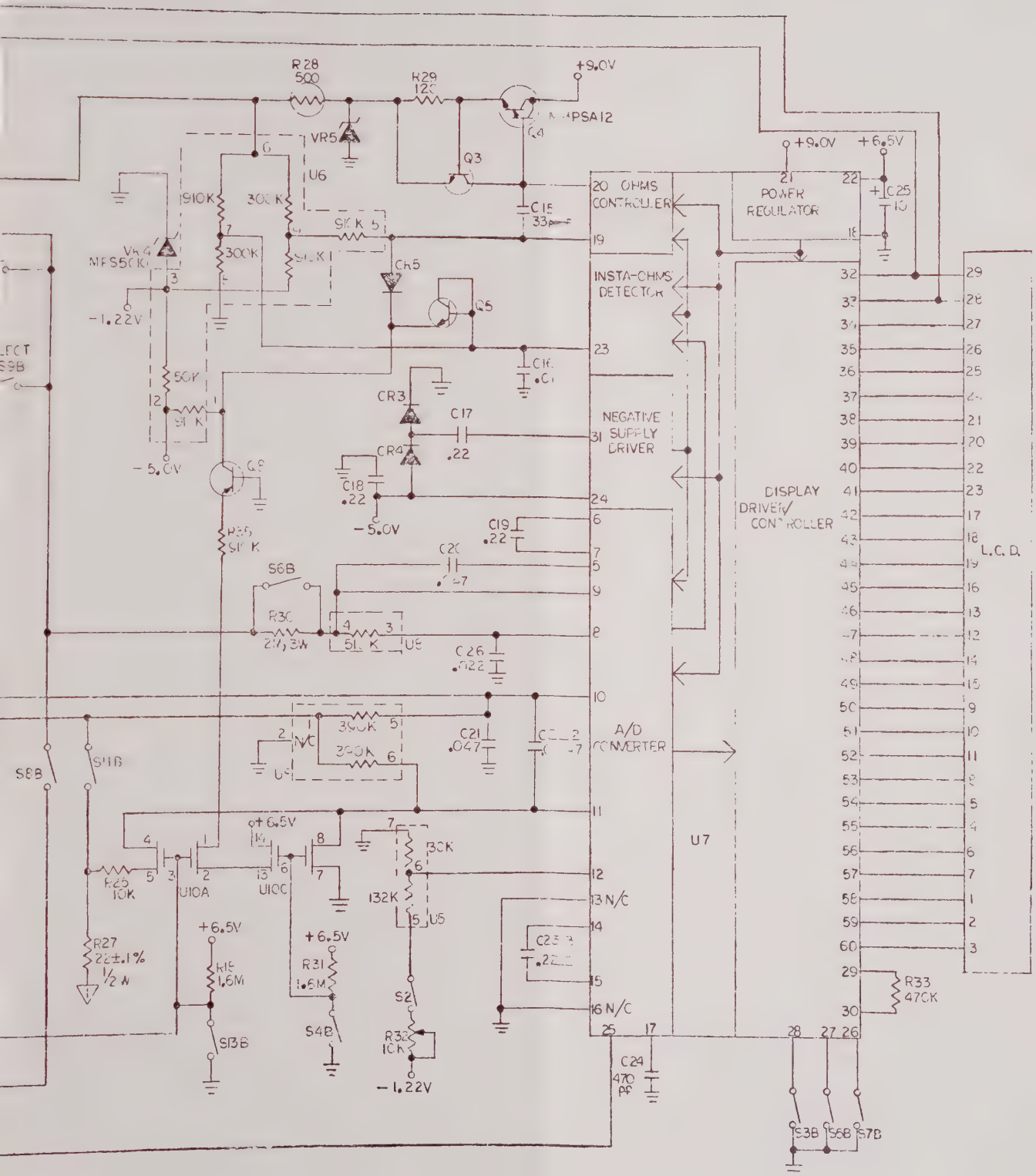
SCHEMATIC DIAGRAM 3000-530-108 Rev. B

HD 100



6. LAST REF. DESIGNATORS USED:
BR1, BT6, C27, CR5, DS1, F2, J3, P3, Q9, R35, S1
5. ALL NPN TRANSISTORS ARE TYPE 2N5[illegible];
ALL PNP TRANSISTORS ARE TYPE 2N[illegible].
4. ALL DIODES ARE TYPE 1N914 OR 1N[illegible].
3. ALL ZENER DIODES ARE TYPE SZG40C16.
2. ALL CAPACITORS ARE IN μf.
1. ALL RESISTORS ARE IN OHMS, ±5%, 1/4 W.

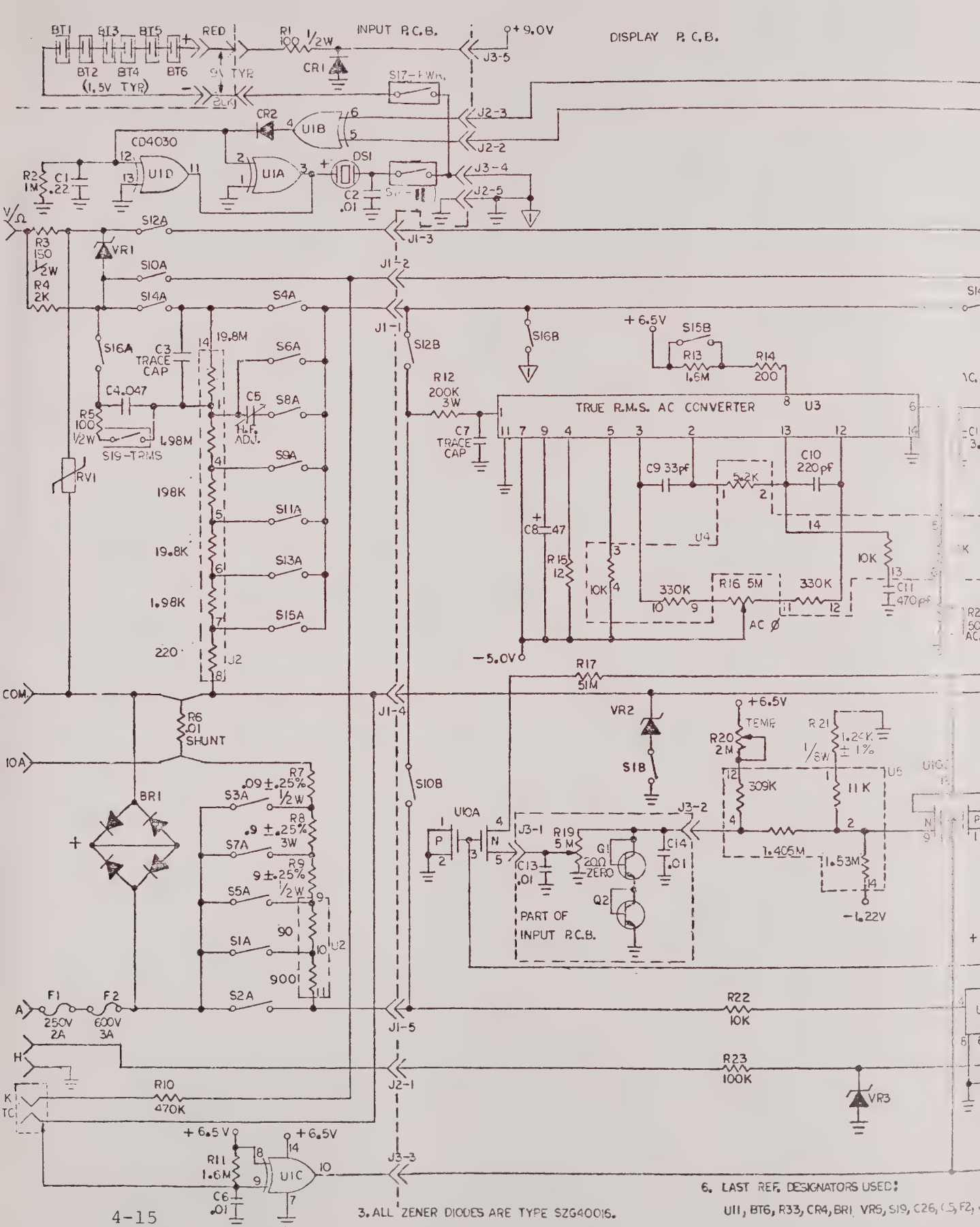
NOTES: UNLESS OTHERWISE SPECIFIED



SCHEMATIC DIAGRAM 3000-530-104 Rev. A

TECH 350, MODEL 3050

...11, VR5.

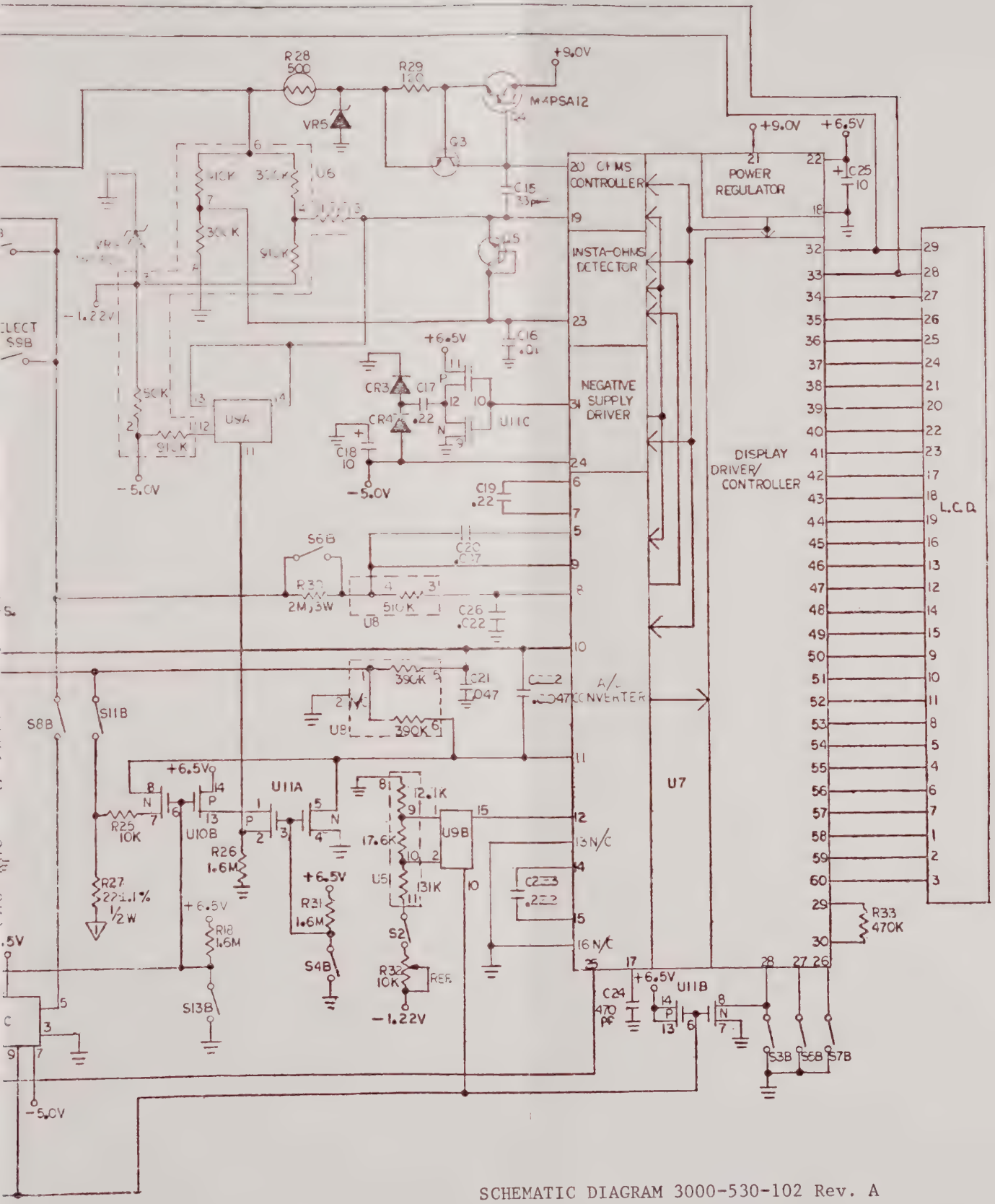


4-15

NOTES: UNLESS OTHERWISE SPECIFIED

3. ALL ZENER DIODES ARE TYPE SZG40015.
2. ALL CAPACITORS ARE IN μf.
1. ALL RESISTORS ARE IN OHMS, ±5%, 1/4 W.

6. LAST REF. DESIGNATORS USED:
U11, BT6, R33, CR4, BR1, VR5, S19, C26, (5, F2,
5. ALL NPN TRANSISTORS ARE TYPE 2N5088.
4. ALL DIODES ARE TYPE IN914 OR IN4



SCHEMATIC DIAGRAM 3000-530-102 Rev. A

TECH 360, MODEL RMS 3060

,P3, DSI.

SECTION FIVE
REPLACEMENT PARTS AND SUPPLIES

The replacement parts and supplies listed in this section may be ordered from Beckman. To determine Beckman part number and description of the part to be replaced, first find the part located on an illustration. Next, note the illustration figure number and parts index number. Locate the identical figure number on the parts list and the part index number. Parts indexed with a letter are available only as part of the assembly kit. Note the Series 3000 covers Models 3000, 3010, 3010UL, 3020, 3020B, and RMS 3030; and that Series 300 covers TECH 300, 310, 310UL, and 320B.

The Spare Parts Quantity column indicates the recommended number of parts necessary to support one to ten instruments for two years. This list omits those common parts that are typically available from local parts suppliers.

NOTE: If a subassembly PC board is needed, please contact the factory service center:

BECKMAN INSTRUMENTS, INC.
210 Ranger Street
Brea, California 92621
714 993-8854

Parts indexed with a letter are available only as part of the main assembly kit.

MULTIMETER ASSEMBLY

Parts List for Figure 5-1

Index No.	Ref Des	Beckman Part No.	Description	Qty. Per Assembly	Spare Parts Qty.
1			Housing Assembly, Front	1	
2		FG3000-450-116	Shield, Upper	1	
3		FG3000-410-116	Battery Cover Assembly	1	
3A		FG3000-420-109	Cover, Battery	1	
3B		FG3000-450-112	Pad, Non-Skid	1	
4			Electronic Assemblies	1	
5		FG3000-450-103	Screw, No. 4, Thread Forming, 1¼-inch	2	
6			Housing Assembly, Rear	1	
7		FG3000-450-104	Screw, 4-40 Block Oxide, 1¼-inch	4	
8		FG3000-543-21	Jack Assembly - Non UL Meters	2 or 3	
8		FG3000-543-23	Jack Assembly - UL Meters	1	
8A		FG3000-370-111	Terminal PC Crimp Female	1	
8B		FG3000-372-116	Wire, 1-7/16 inch long	1	
8C		FG3000-370-106	Receptical, Measuring Probe Input	1	

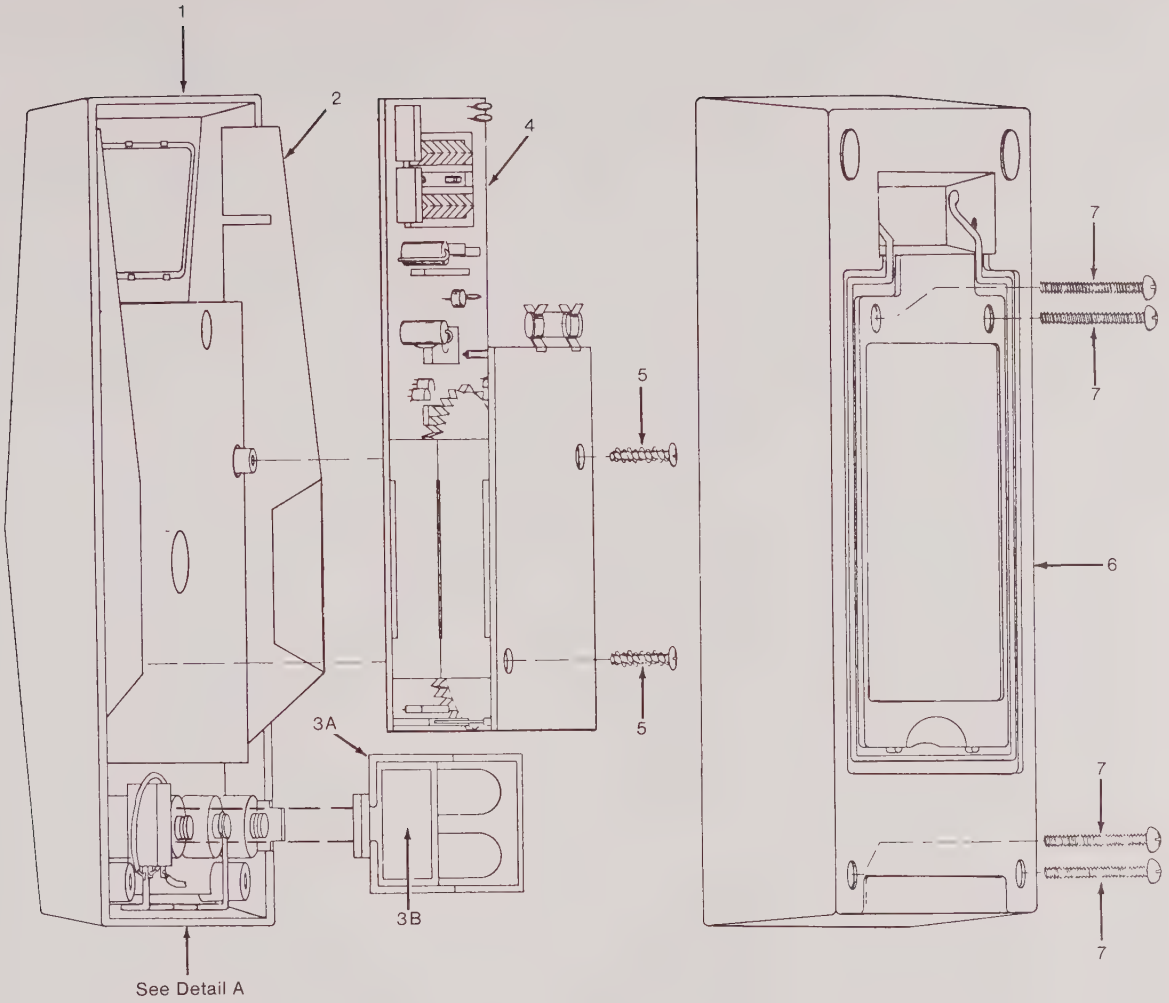
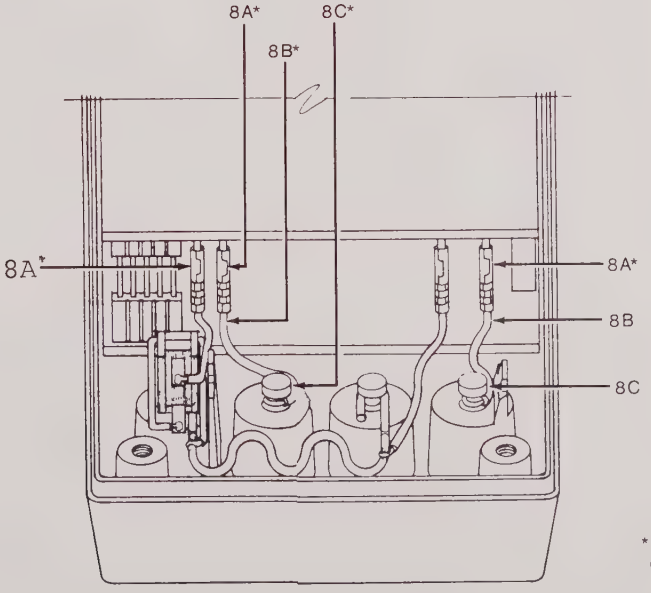


Figure 5-1. Multimeter Assembly



*Do not solder these connections

Detail A

Parts indexed with a letter are available only as part of the main assembly kit.

REAR HOUSING ASSEMBLY

Parts List for Figure 5-2

Index No.	Ref Des	Beckman Part No.	Description	Qty. Per Assembly	Spare Parts Qty.
1		FG3000-410-108	Series 3000 Rear Case Assembly	1	
1		FG3000-410-109	Series 300 Rear Case Assembly	1	
1		FG3000-420-143	320 Beeper Rear Case Assembly	1	
1		FG3000-421-143	3020 Beeper Rear Case Assembly	1	
1A		FG3000-420-104	Rear Case, Series 300	1	
1A		FG3000-420-150	Rear Case, Beeper - 320	1	
1A		FG3000-421-104	Rear Case, Series 3000	1	
1A		FG3000-421-150	Rear Case, Beeper - 3020	1	
1B		FG3000-450-108	Pad, Bottom	1	
1C		FG3000-450-107	Foot, Top	2	
1D		FG3000-400-101	Fuse, 2-Amperes	1	
1E		FG3000-451-100	Bail, Multimeter Tilt	1	
2		FG3000-410-115	Shield, Lower with Reassembly Instruction and Foam Pad	1	
2A		FG3000-450-111	Pad	1	
2B		FG3000-450-117	Shield	1	
2C		FG3000-970-201	Label	1	
3		FG3000-920-105	Overlay Instructions, 3010 UL	1	
3		FG3000-920-106	Overlay Instructions, Tech 310 UL	1	
3		FG3000-920-500	Overlay Instructions, Series 300	1	
3		FG3000-920-501	Overlay Instructions, Series 3000	1	
4		FG3000-451-100	Bail, Multimeter Tilt	1	

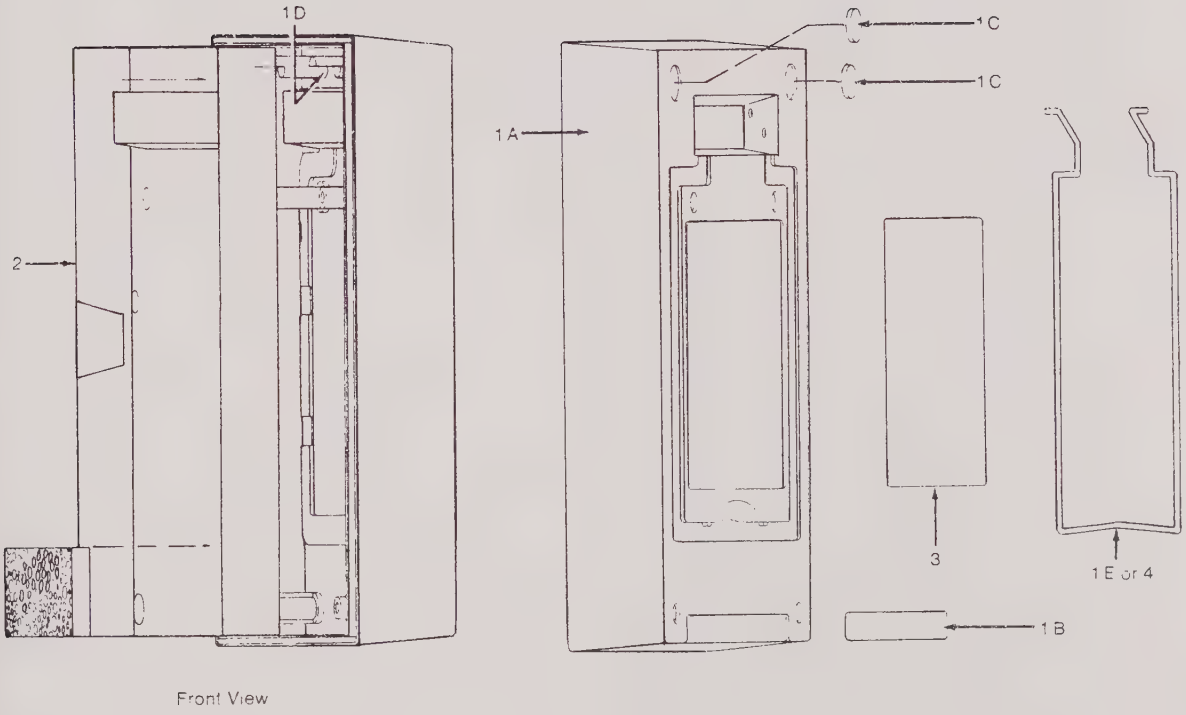


Figure 5-2. Rear Housing Assembly

Parts indexed with a letter are available only as part of the main assembly kit.

FRONT HOUSING ASSEMBLY

Parts List for Figure 5-3

Index No.	Ref Des	Beckman Part No.	Description	Qty. Per Assembly	Spare Parts Qty.
1		FG3000-410-110	Series 3000 Case Top Assembly	1	
1		FG3000-410-111	TECH 300 Case Top Assembly	1	
1		FG3000-410-112	TECH 310/330 Case Top Assembly	1	
1		FG3000-420-144	310 UL Top Case Assembly	1	
1		FG3000-421-144	3010 UL Top Case Assembly	1	
1A		FG3000-920-400	Overlay, Knob Insert, Series 3000	1	
1A		FG3000-920-401	Overlay, Knob Insert, Series 300	1	
1B		FG3000-420-105	Knob, Function/Range Switch, Tan	1	
1B		FG3000-421-105	Knob, Function/Range Switch, Blue	1	
1C		FG3000-450-105	O-Ring, Knob Sealing	1	
1D		FG3000-920-100	Overlay, Switch, TECH 300	1	
1D		FG3000-920-101	Overlay, Switch, TECH 310, 330	1	
1D		FG3000-920-102	Overlay, Switch, Series 3000	1	
1D		FG3000-920-109	Overlay, Switch, TECH 310 UL	1	
1D		FG3000-920-108	Overlay, Switch, 3010 UL	1	
1E		FG3000-420-103	Case, Top Series 300	1	
1E		FG3000-421-103	Case, Top Series 3000	1	
1E		FG3000-423-156	Case Top, 3010UL	1	
1E		FG3000-424-156	Case Top, 310UL	1	
1F		FG3000-420-102	Shaft, Function Range	1	
1G		FG3000-450-154	Seal, Display Window	1	
1H		FG3000-420-106	Window, Display	1	
2		FG3000-920-300	Overlay, Logo, TECH 300	1	
2		FG3000-920-301	Overlay, Logo, TECH 310	1	
2		FG3000-920-302	Overlay, Logo, TECH 330	1	
2		FG3000-920-304	Overlay, Logo, TECH 310UL	1	
2		FG3000-920-305	Overlay, Logo, ISTECH 300A	1	
2		FG3000-920-306	Overlay, Logo, Model 3000	1	
2		FG3000-920-310	Overlay, Logo, 3010	1	
2		FG3000-920-320	Overlay, Logo, 3020	1	
2		FG3000-920-321	Overlay, Logo, 3010UL	1	
2		FG3000-920-330	Overlay, Logo, 3030	1	
3		FG3000-920-201	Overlay, Input Jacks, TECH 300	1	
3		FG3000-920-202	Overlay, Input Jacks, TECH 320,330	1	
3		FG3000-920-203	Overlay, Input Jacks, Series 3000	1	
3		FG3000-920-204	Overlay, Input Jacks, TECH 310 UL	1	
3		FG3000-920-205	Overlay, Input Jacks, 3010 UL	1	
4*		FG3000-526-21	10-Ampere Shunt Assembly	1	
4		FG3000-526-22	10-Ampere Shunt Assembly UL	1	

*Not Included in Model 3000

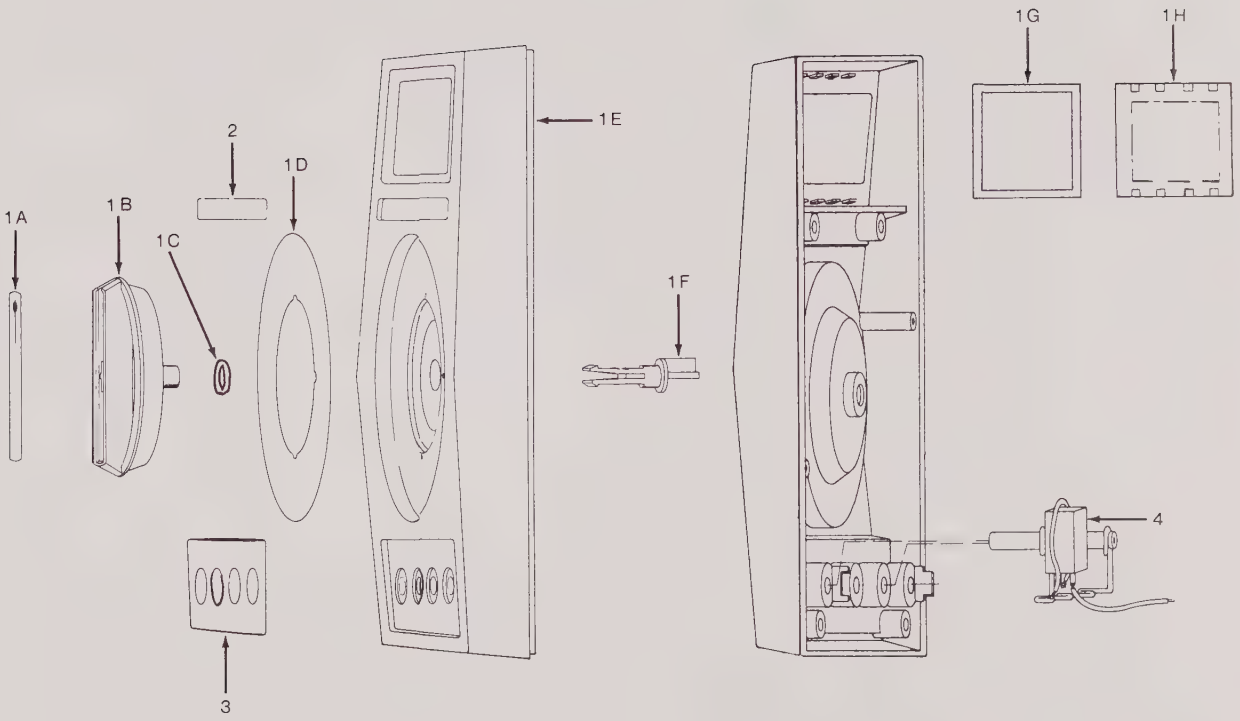


Figure 5-3. Front Housing Assembly

Parts List for Figure 5-4

Index No.	Ref Des	Beckman Part No.	Description	Qty. Per Assembly	Spare Parts Qty.
1			Circuit Board Assembly, Small	1	1
2	F1	FG3000-400-101	Fuse, 2-Ampere	1	5
3			Circuit Board and Display Assembly	1	
4		FG3000-450-102	Screw, No. 6, Thread Forming, 3/4-inch	2	
5		FG3000-450-110	Spring Detent	1	
6		FG3000-420-101	Cam, Function/Range Switch	1	
7		FG3000-370-115	Spring Contact, DSN Aquadag	1	1

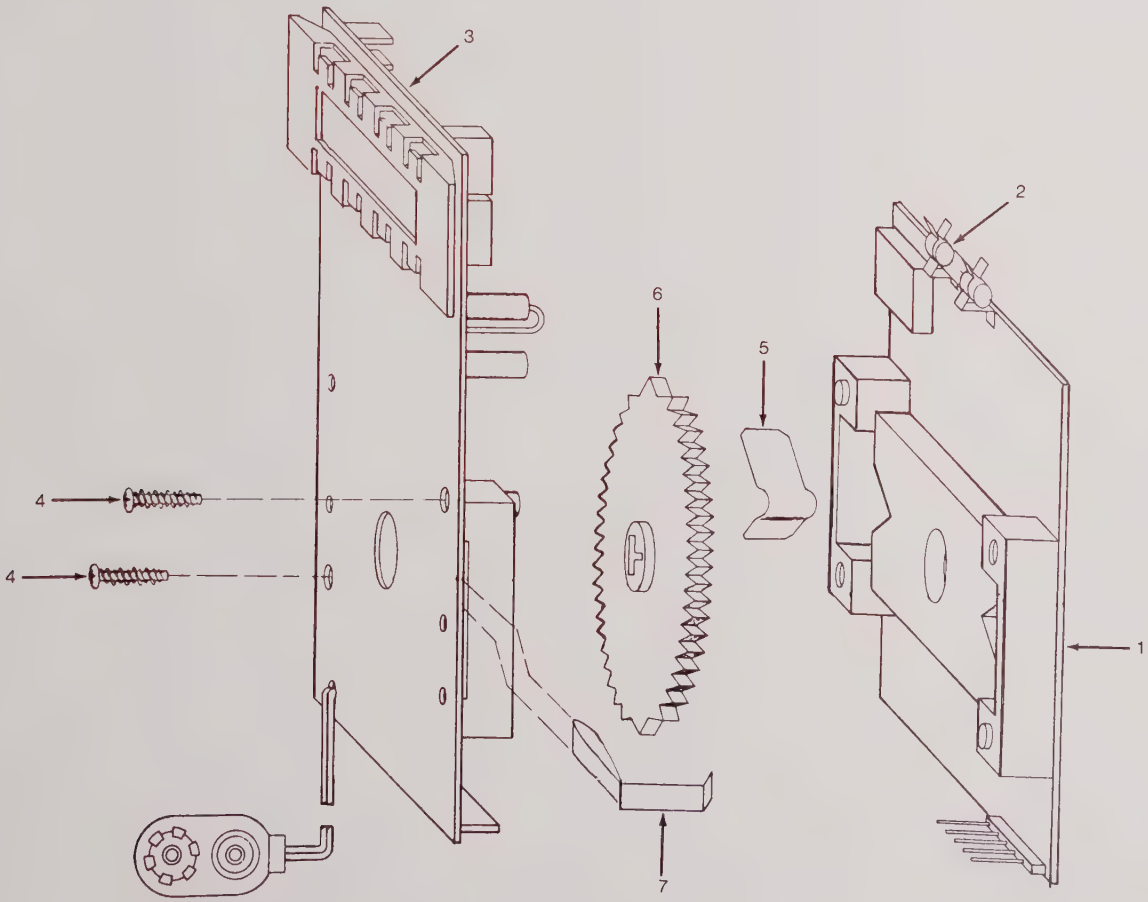


Figure 5-4. Electronics Assembly

SMALL CIRCUIT BOARD ASSEMBLY
3010, 3020, 3020B, TECH 300, TECH 310, TECH 320B)

Parts List for Figure 5-5

Index No.	Ref Des	Beckman Part No.	Description	Qty. Per Assembly	Spare Parts Qty.
1	BR1	FG3000-211-100	Bridge, 2-Ampere, Low Leakage	1	
2		FG3000-370-100	Connector, Male, 5-Pin	1	
3	R1	FG3000-1-202	Resistor, 2k Ohm +5%, ¼%WW	1	
4	R2	FG3000-51-106	Resistor, 9 Ohms, 3W, ¼%WW	1	
5	R3	FG3000-71-101	Resistor, 0.9 Ohm, 3W, ¼%WW	1	
6	R4	FG3000-71-100	Resistor, 0.1 Ohm, 3W, ¼%WW	1	
7	U1	FG3000-312-101	Resistor Network, Attenuator (TECH 310, Model 3010, TECH 310UL, Model 3010UL)	1	
7	U1	FG3000-313-101	Resistor Network, Attenuator (TECH 330, RMS 3030, Model 3020)	1	
7	U1	FG3000-410-118	Resistor Network, Attenuator (TECH 300)	1	
8	SG1	FG3000-401-100	Spark Gap 2kV	1	
9		FG3000-420-100	Switch Block	1	
10		FG3000-370-110	Terminal Pin, Male	4	2
11	C1	FG3000-130-100	Capacitor, Metalized Polyester, 0.047 µf .250V	1	
12		FG3000-370-107	Fuse Clip	2	2

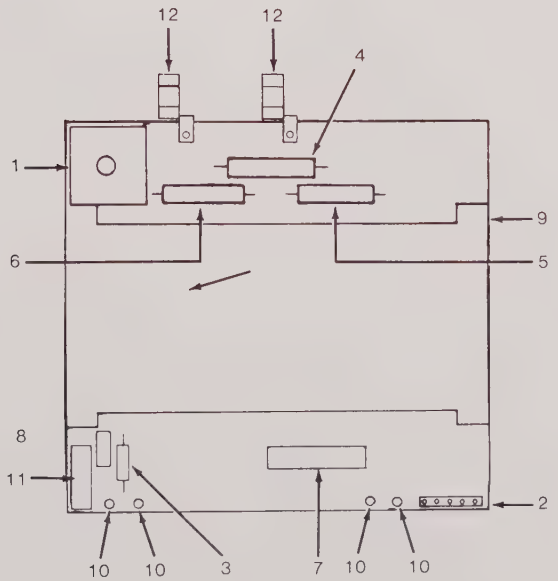


Figure 5-5. Small Circuit Board Assembly (3010, 3020, TECH 300, and TECH 310) for Part Location

Index No.	Ref Des	Beckman Part No.	Description	Qty. Per Assembly	Spare Parts Qty.
1	BR1	FG3000-211-100	Bridge, 2-Ampere, Low Leakage	1	
2		FG3000-370-100	Connector, Male, 5-Pin	1	
3	R1	FG3000-1-202	Resistor, 2k Ohm +5%, ¼%W	1	
4	R2	FG3000-51-106	Resistor, 9 Ohms, 3W, ¼%WW	1	
5	R3	FG3000-71-101	Resistor, 0.9 Ohm, 3W, ¼%WW	1	
6	R4	FG3000-71-100	Resistor, 0.1 Ohm, 3W, ¼%WW	1	
7	U1	FG3000-313-101	Resistor Network, Attenuator, Thin Film	1	1
8*	SG1	FG3000-80-102	MOV	1	
8	SG1	FG3000-401-100	Spark Gap, 2kV	1	
9		FG3000-420-100	Switch, Block	1	
10		FG3000-370-110	Terminal Pin, Male	4	2
11	C19	FG3000-191-100	Capacitor, Trimmer	1	1
12		FG3000-370-107	Fuse Clip	2	2

*FG3000-80-102 Replaces FG3000-401-100 in Newer Models.

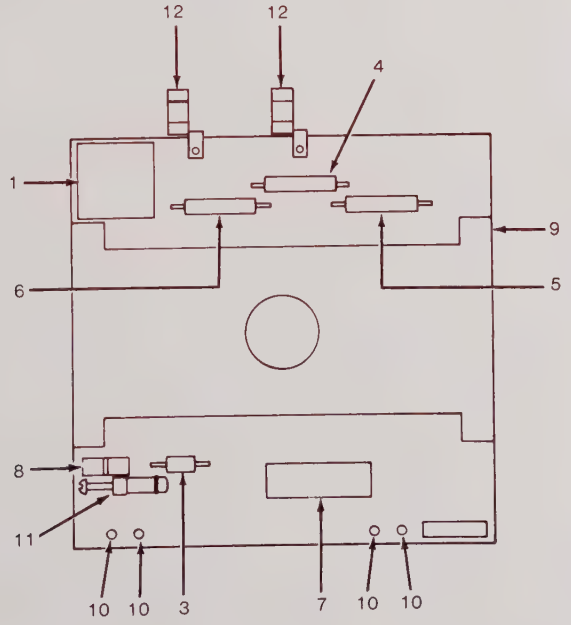


Figure 5-6. Small Circuit Board Assembly (RMS 3030 and TECH 330) for Part Location

Parts indexed with a letter are available only as part of the main assembly kit.

CIRCUIT BOARD AND DISPLAY ASSEMBLY

Parts List for Figure 5-7

Index No.	Ref Des	Beckman Part No.	Description	Qty. Per Assembly	Spare Parts Qty.
1			Circuit Board Assembly Large	1	
2		FG3000-410-113	Series 3000 LCD Retainer Assembly	1	
2		FG3000-410-114	Series 300 LCD Retainer Assembly	1	
2A		FG3000-920-600	Mask Window, Series 300	1	
2A		FG3000-920-601	Mask Window, Series 3000	1	
2B		FG3000-420-107	Retainer, Liquid Crystal Display	1	
3		FG3000-390-100	Liquid Crystal Display (3½ Digits)	1	1
4		FG3000-370-102	Elastomeric Connector, Carbon-Filled	1	2
5		FG3000-420-111	Connector, Liquid Crystal Display	1	2
6		FG3000-420-110	Connector, Multiprocessor Chip	1	
7		FG3000-370-103	Connector, Elastomeric, Silver-Filled	2	2
8	U4	FG3000-270-100	Integrated Circuit, Multiprocessor	1	1
9		FG3000-420-108	Chip Retainer	1	
10		FG3000-420-141	Retainer Mount (3020B, Tech 320B)	1	
11		FG3000-360-101	Buzzer (3020B, Tech 320B)	1	

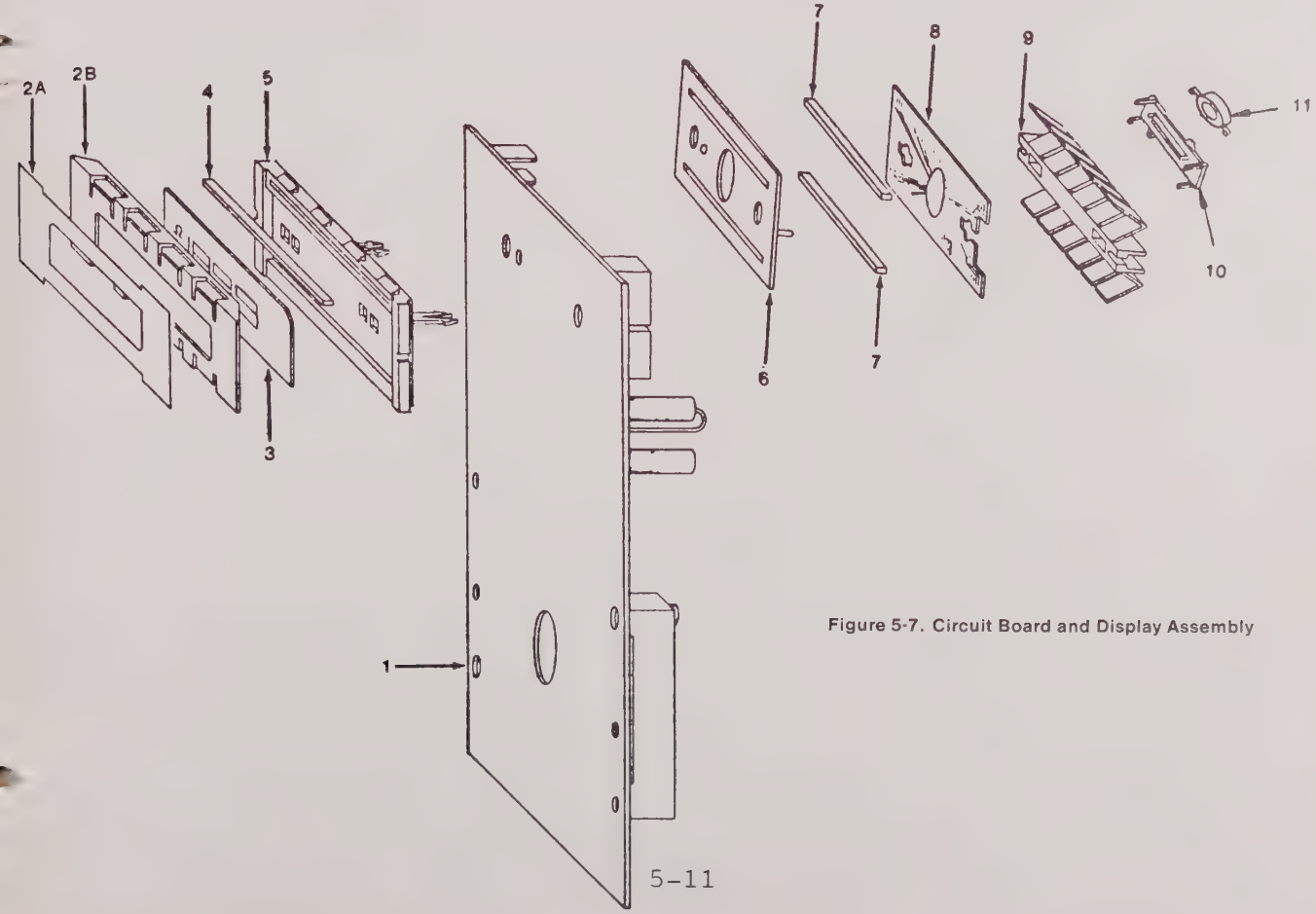


Figure 5-7. Circuit Board and Display Assembly

LARGE CIRCUIT BOARD ASSEMBLY (3000, TECH 300A, 3010, 3010UL, 3020, TECH 300, TECH 310, TECH 310UL)

Parts List for Figure 5-8

Index No.	Ref Des	Beckman Part No.	Description	Qty. Per Assembly	Spare Parts Qty.
1	C2,5	FG3000-111-100	Capacitor, 0.22 µf/25V, Min., Ceramic	2	
2	C10	FG3000-101-100	Capacitor, 470 pf, Disc Ceramic	1	
3	C8,9	FG3000-130-102	Capacitor, 0.22 µf, 100V, Min., Metalized Polyester	2	
4	C6	FG3000-130-101	Capacitor, 0.022 µf, 250V, Metalized Polyester	1	
5	C4,7	FG3000-130-100	Capacitor, 0.047 µf, 250V, Metalized Polyester	2	
6	C3,11	FG3000-151-101	Capacitor, 10 µf/10V, Min., Tantalum	2	
7	C12	FG3000-151-100	Capacitor, 3.3 µf/20V, Min., Tantalum	1	
8	CR1,2,3	FG3000-201-100	Diode, Small Signal	3	
9	VR1	FG3000-231-102	Diode, Reference, 1.2V	1	
10	VR2,3	FG3000-231-101	Diode, Zener, Low Leakage	2	
11	R7	FG3000-1-474	Resistor, 470K Ohm +5%, ¼W	1	
12	R6	FG3000-1-101	Resistor, 100 Ohm +5%, 1/3W	1	
13	R8	FG3000-51-102	Resistor, 2M Ohm +5%, 3W	1	
14	R9	FG3000-51-101	Resistor, 200K Ohm +5%, 3W	1	
15	U3	FG3000-300-100	Resistor Network, 10-Pin SIP	1	
16	R10	FG3000-81-100	Resistor, Positive TC	1	
17	U2	FG3000-310-100	Reference Divider, Thin Film	1	
18	R5	FG3000-90-101	Variable Resistor, 10K +10%	1	
19	Q2	FG3000-251-102	Transistor, NPN, Darlington MPS A12	1	
20	Q1	FG3000-251-101	Transistor, NPN, General Purpose, 2N5088	1	
21	Q3,4	FG3000-251-100	Transistor, PNP, General Purpose, 2N4126	2	
22		FG3000-371-105	Connector, Battery Snap Terminals	1	2
23		FG3000-370-101	Connector, Female, 5-pin	1	
24		FG3000-420-100	Switch Block	1	

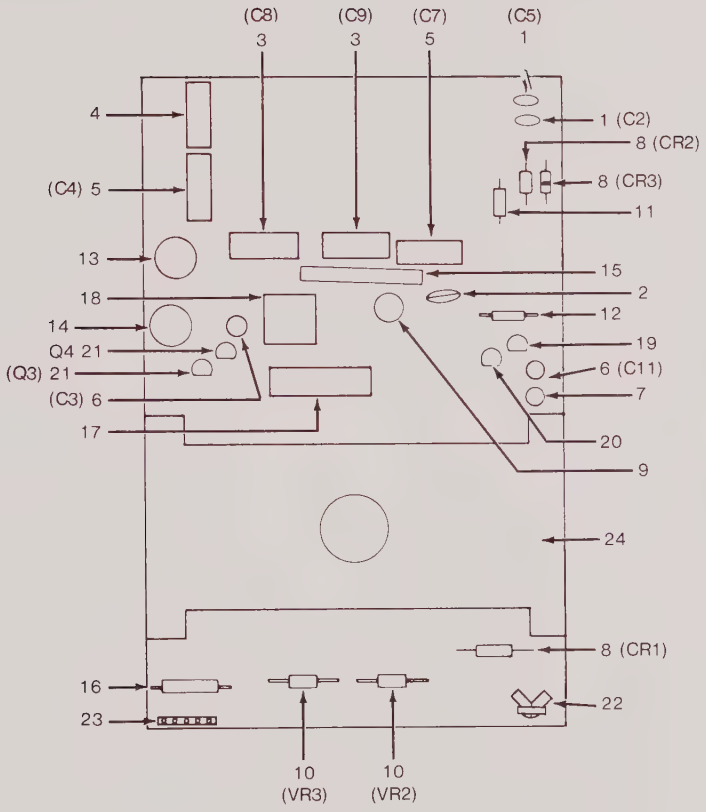


Figure 5-8. Large Circuit Board Assembly for Part Location

Index No.	Ref Des	Beckman Part No.	Description	Qty. Per Assembly	Spare Parts Qty.
1		FG3000-420-100	Switch Block	1	
2	U2	FG3000-310-100	Reference Divider, Thin Film	1	
3	U3	FG3000-300-100	Resistor Network, 10-Pin SIP	1	
4	U8	FG3000-270-104	IC, CD 4030	1	
5	Q3,4	FG3000-251-100	Transistor, PNP, General Purpose, 2N4126	2	
6	Q1	FG3000-251-101	Transistor, NPN, General Purpose, 2N5088	1	
7	Q2	FG3000-251-102	Transistor, NPN, Darlington MPS A12	1	
8	CR1,2,3 4,5	FG3000-201-100	Diode, Small Signal	5	
9	VR2,3	FG3000-231-101	Diode, Zener, Low Leakage	2	
10	VR1	FG3000-231-102	Diode, Reference, 1.2V	1	
11	R16	FG3000-001-474	Resistor, 470K Ohm	1	
12	C10	FG3000-101-100	Capacitor, 470 pf, Disc Ceramic	1	
13	C2,5,19 20	FG3000-111-100	Capacitor, 0.22 µf/25V, Min., Ceramic	4	
14	C8,9	FG3000-130-102	Capacitor, 0.22 µf, 100V, Mylar	2	
15	C6	FG3000-130-101	Capacitor, 0.022 µf, 250V, Mylar	1	
16	C4,7	FG3000-130-100	Capacitor, 0.047 µf, 250V, Mylar	2	
17	C12	FG3000-151-100	Capacitor, 3.3 µf/20V, Min., Tantalum	1	
18	C3	FG3000-151-101	Capacitor, 10 µf/10V, Min., Tantalum	1	
19	C11	FG3000-161-100	Capacitor, 10 µf, Electrolytic	1	
20	R15	FG3000-001-104	Resistor, 100K Ohm, 1/4W	1	
21	R6	FG3000-001-241	Resistor, 240 Ohm, 1/4W	1	
22	R7	FG3000-001-474	Resistor, 470K Ohm, 1/4W	1	
23	R9	FG3000-051-101	Resistor, 200K Ohm, 3W	1	
24	R8	FG3000-051-102	Resistor, 2M Ohm, 3W	1	
25	R10	FG3000-082-103	Resistor, Pos. TC, 750 Ohm	1	
26	R5	FG3000-090-101	Potentiometer, 10K Ohm	1	
27		FG3000-370-176	Beeper Terminal	2	
28		FG3000-370-144	Connector, Female, 5-Pin	1	
29		FG3000-370-187	Connector, Battery Snap	1	
30		FG3000-450-118	Cable Tie	1	

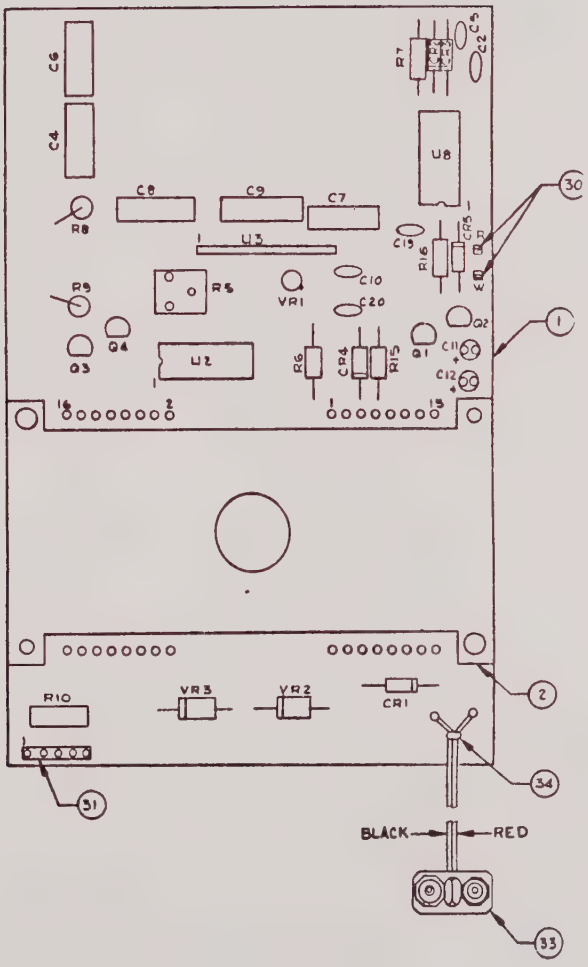


Figure 5-9. Large Circuit Board Assembly for Part Location (3020B and Tech 320B)

Index No.	Ref Des	Beckman Part No.	Description	Qty. Per Assembly	Spare Parts Qty.
1	C5	FG3000-111-100	Capacitor, 0.22 µf, 25V, Min., Ceramic	1	
2	C14,15	FG3000-101-101	Capacitor, 33 pf, Disc Ceramic	2	
3	C10,13, 16	FG3000-101-100	Capacitor, 470 pf, Disc Ceramic	3	
4	C18	FG3000-101-102	Capacitor, 4.7 pf, Disc Ceramic	1	
5	C4,7	FG3000-130-100	Capacitor, 0.047 µf, 250V Min., Metalized Polyester	2	
6	C8,9	FG3000-130-102	Capacitor, 0.22 µf, 100Vdc, Min., Metalized Polyester	2	
7	C6	FG3000-130-101	Capacitor, 0.022 µf, 250Vdc, Min., Metalized Polyester	1	
8	C17	FG3000-151-102	Capacitor, 47 µf/6V, Min., Tantalum	1	
9	C11,C2	FG3000-151-101	Capacitor, 10µf/10V Min., Tantalum	2	
10	C12	FG3000-151-100	Capacitor, 3.3 µf/20V min., Tantalum	1	
11	VR1	FG3000-231-102	Diode, Reference, 1.2V	1	
12	VR2,3	FG3000-231-101	Diode, Zener, Low Leakage	2	
13	CR1,2,3	FG3000-201-100	Diode, Small Signal	3	
14	U6	FG3000-270-102	Integrated Circuit, Hex Inverter 4069	1	1
15	U7	FG3000-270-101	Integrated Circuit, RMS Converter	1	1
16	R5	FG3000-90-101	Resistor, Variable, 10k +10%	1	
17	R12	FG3000-1-120	Resistor, 12 Ohm +5%, ¼W	1	
18	R7	FG3000-1-474	Resistor, 470k Ohm +5%, ¼W	1	
19	R6	FG3000-1-101	Resistor, 100 Ohm +5%, ¼W	1	
20	R11	FG3000-1-165	Resistor, 1.6 Megohm +5%, ¼W	1	
21	R8	FG3000-51-102	Resistor, 2M Ohm +5%, Metal Film, 3W	1	
22	R9	FG3000-51-101	Resistor, 200k Ohm +5%, Metal Film, 3W	1	
23	U5	FG3000-300-102	Resistor, Network, 8-Pin Sip	1	
24	U3	FG3000-300-100	Resistor, Network, 10-Pin Sip	1	
25	R10	FG3000-81-100	Resistor, Positive, T.C.	1	
26	R14	FG3000-90-102	Resistor, Variable, 500 Ohm +10%	1	
27	R13	FG3000-90-103	Resistor, Variable, 5M Ohm +20%	1	
28	U2	FG3000-310-100	Reference Divider, Thin Film	1	
29	Q2	FG3000-251-102	Transistor, NPN Darlington, MPS A12	1	
30	Q1	FG3000-251-101	Transistor, NPN, General Purpose, 2N5088	1	
31		FG3000-371-105	Connector, Battery Snap Terminals	1	
32		FG3000-370-101	Connector, Female, 5-Pin	1	
33		FG3000-420-100	Switch Block	1	

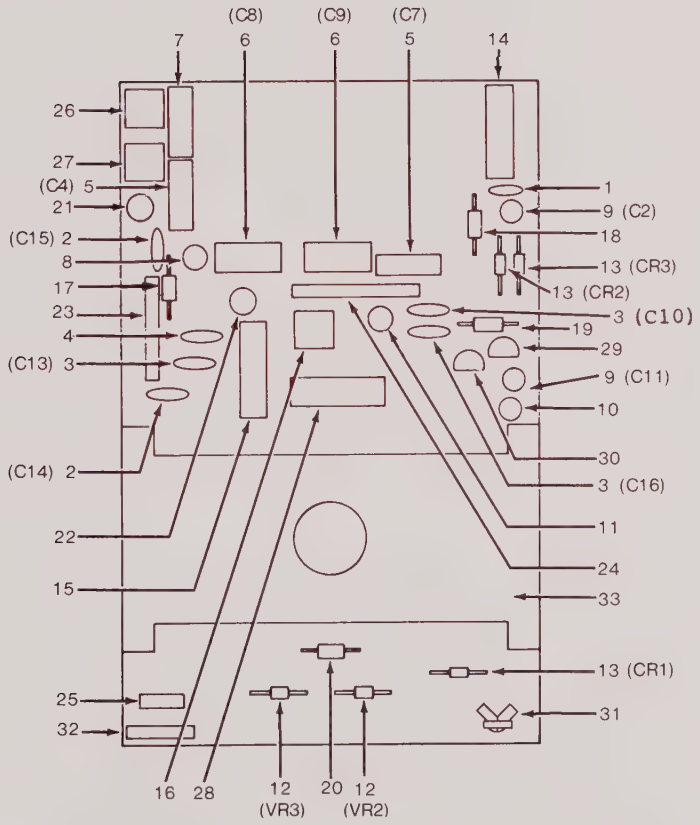
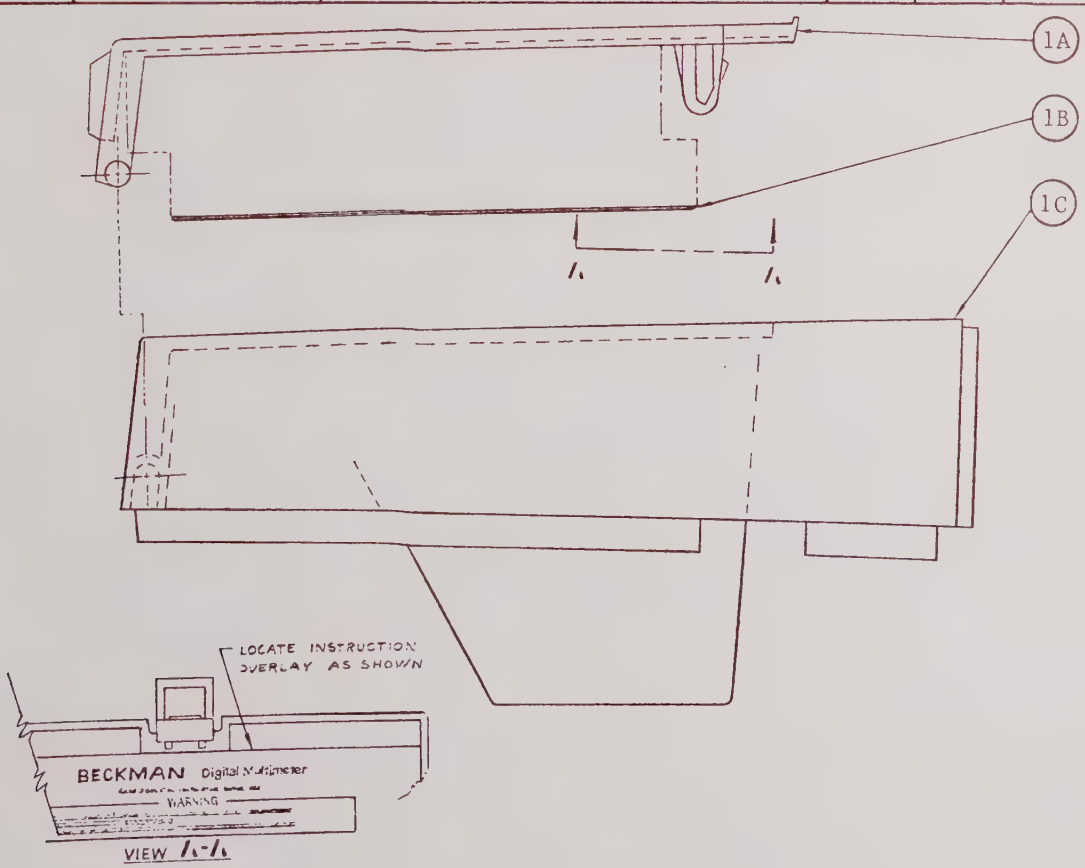


Fig. 5-10 **Large Circuit Board Assembly (RMS 3030 and TECH 330) for Part Location**

Parts indexed with a letter are available only as part of the main assembly kit.

REAR HOUSING TOP, BENCH METERS

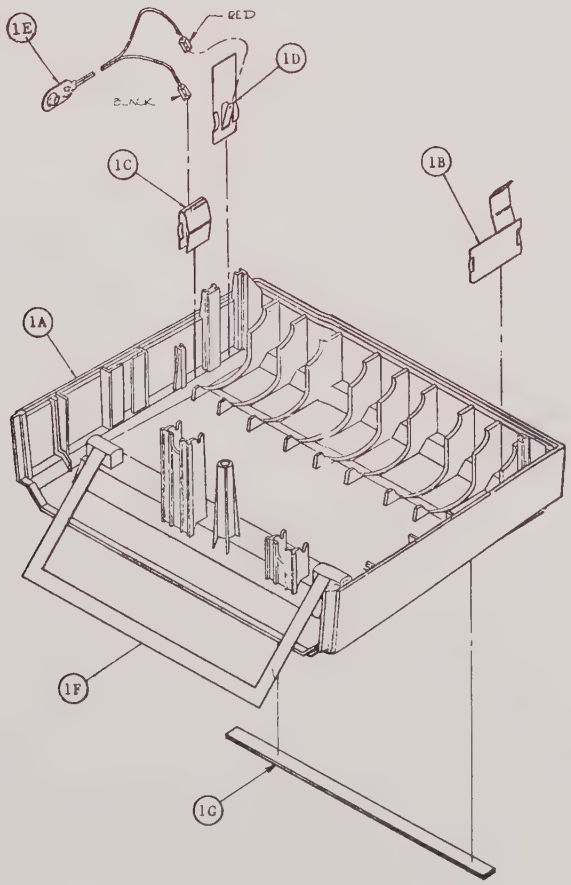
Index No.	Beckman Part No.	Description	Quantity 350	360	3050	3060
1	FG3000-420-160	Rear Housing Top Kit - 3050				
1	FG3000-420-161	Rear Housing Top Kit - 3060				
1	FG3000-420-162	Rear Housing Top Kit - Tech 350				
1	FG3000-420-163	Rear Housing Top Kit - Tech 360				
1A	FG3000-420-134	Rear House, Top, Beige	1	1		
1A	FG3000-421-134	Rear House, Top-Gray			1	1
1B	FG3000-420-135	Lid, Beige	1	1		
1B	FG3000-421-135	Lid, Gray			1	1
1C	FG3000-920-104	Instruction Overlay, Non-RMS	1		1	
1C	FG3000-921-104	Instruction Overlay, RMS		1		1



Parts indexed with a letter are available only as part of the main assembly kit.

REAR HOUSING BOTTOM, BENCH METERS

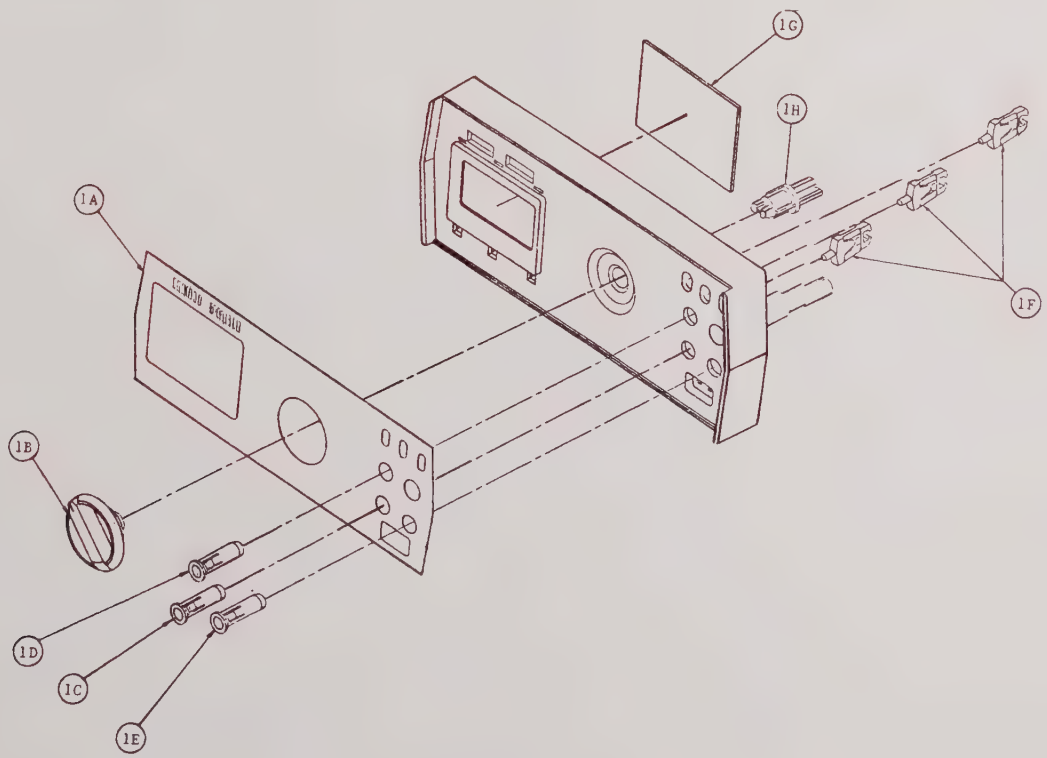
Index No.	Beckman Part No.	Description	Quantity Series 300	Quantity Series 3000
1	FG3000-420-168	Rear Housing Bottom Kit, Gray		1
1	FG3000-420-169	Rear Housing Bottom Kit, Beige	1	
1A	FG3000-570-110	Rear Housing, Beige		1
1A	FG3000-571-110	Rear Housing, Gray	1	
1B	FG3000-371-153	Battery Contact, Dual	1	1
1C	FG3000-371-154	Battery Contact, Negative	1	1
1D	FG3000-371-155	Battery Contact, Positive	1	1
1E	FG3000-570-108	Assembly, Battery Connector	1	1
1F	FG3000-420-136	Bail, Beige	1	
1F	FG3000-421-136	Bail, Gray		1
1G	FG3000-450-133	Non-skid Pad	1	1



Parts indexed with a letter are available only as part of the main assembly kit.

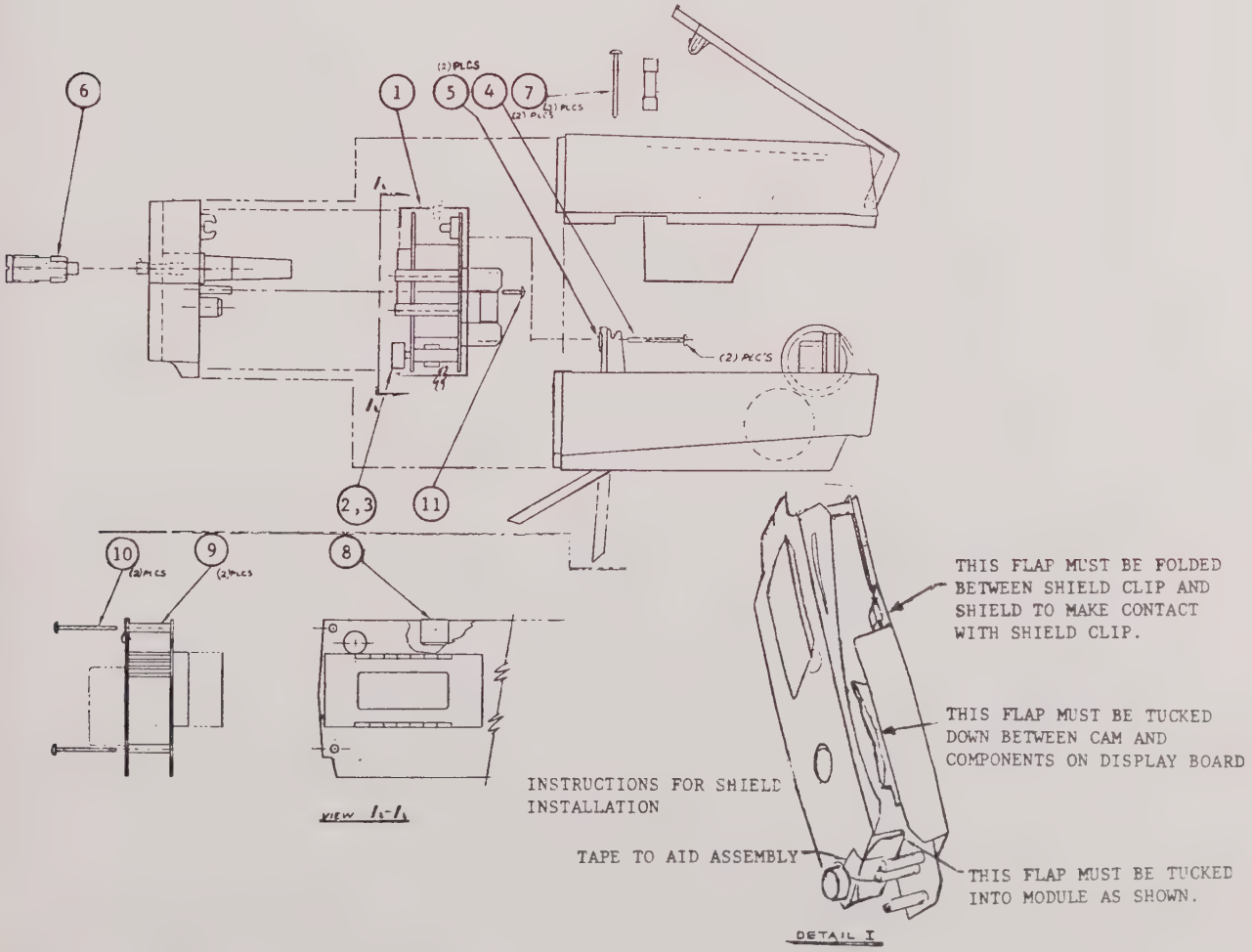
FRONT PANEL ASSEMBLY BENCH METERS

Index No.	Beckman Part No.	Description	Quantity Tech 350	Tech 360	3050	3060
1	FG3000-420-164	3050 Front Panel Kit				
1	FG3000-420-165	3060 Front Panel Kit				
1	FG3000-420-166	Tech 350 Front Panel Kit				
1	FG3000-420-167	Tech 360 Front Panel Kit				
1A	FG3000-921-103	Tech 360 Front Overlay		1		
1A	FG3000-922-103	3050 Front Overlay			1	
1A	FG3000-923-103	3060 Front Overlay				1
1A	FG3000-920-103	Tech 350 Front Overlay	1			
1B	FG3000-420-128	Knob, Beige	1	1		
1B	FG3000-421-128	Knob, Gray			1	1
1C	FG3000-422-123	Red Input Insert	1	1	1	1
1D	FG3000-421-123	White Input Insert	1	1	1	1
1E	FG3000-420-123	Black Input Insert	1	1	1	1
1F	FG3000-420-131	Toggle Switch	2	3	2	3
1G	FG3000-450-138	Window	1	1	1	1
1H	FG3000-420-130	Shaft	1	1	1	1
1I	FG3000-420-132	Front Panel, Beige	1	1		
1I	FG3000-421-132	Front Panel, Gray			1	1



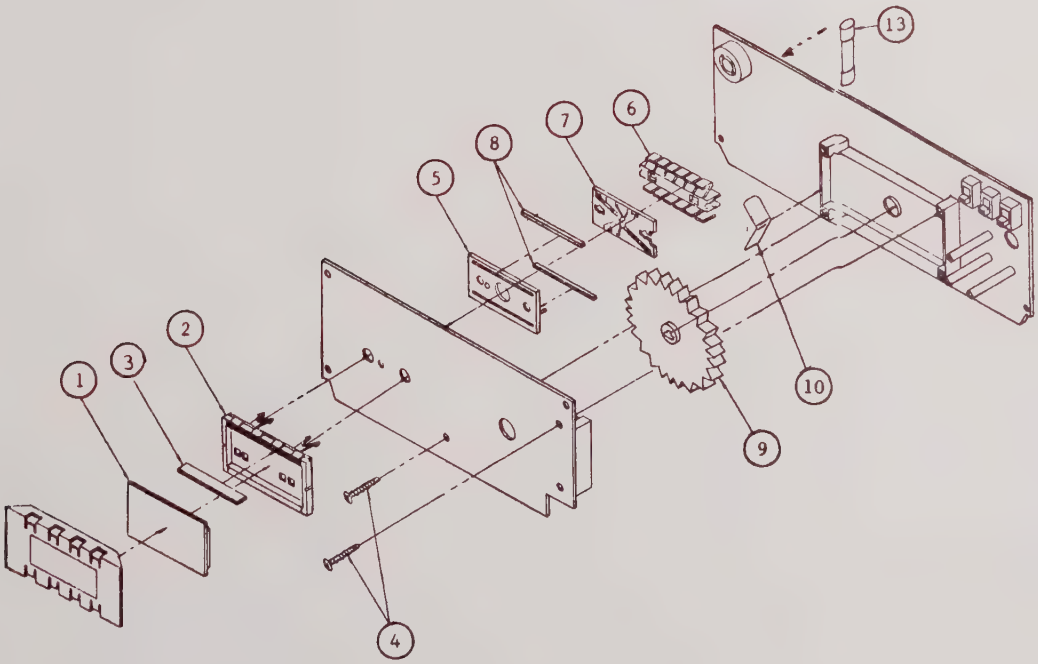
BENCH MULTIMETER ASSEMBLY

Index No.	Beckman Part No.	Description	Qty.
1	FG3000-570-113	Shield Sub-assembly	1
2	FG3000-421-129	Pot Knob, Gray Series 3000	1
3	FG3000-420-129	Pot Knob, Beige, Series 300	1
4	FG3000-450-132	Screw, #4-40 X 1½	2
5	FG3000-420-139	Spacer, Grommet	2
6	FG3000-570-125	Fuse Holder Assembly	1
7	FG3000-450-142	Screw, #6-32 X 1½	3
8	FG3000-371-167	Shield Clip	1
9	FG3000-420-126	Spacer	2
10	FG3000-450-103	Screw #4	2
11	FG3000-450-106	Screw #4 RF	1



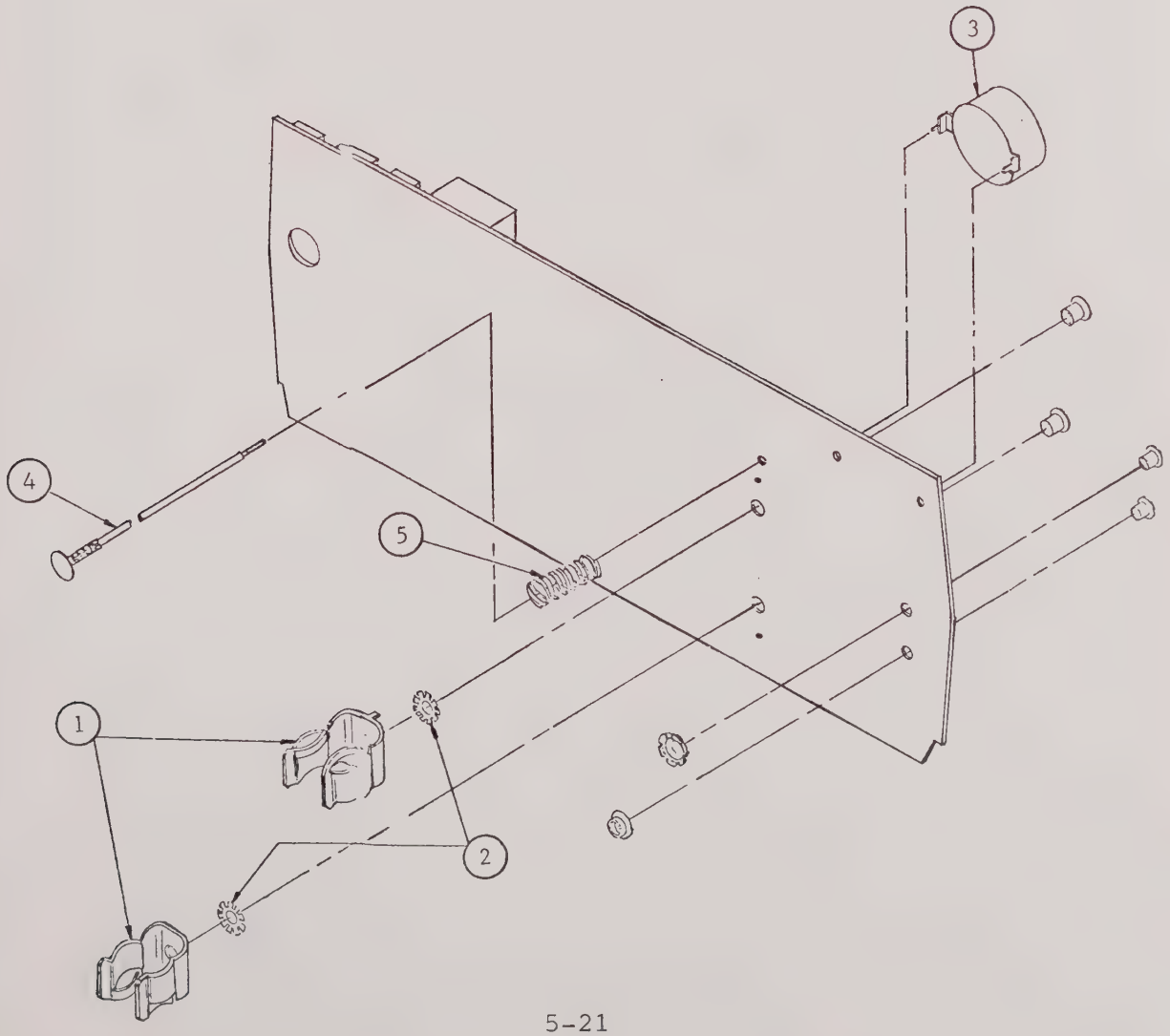
BENCH METERS - ELECTRONICS ASSEMBLY

Index No.	Beckman Part No.	Description	Qty.
1	FG3000-390-100	Liquid Crystal Display	1
2	FG3000-420-111	LCD Connector	1
3	FG3000-370-102	Carbon Zebra	1
4	FG3000-450-102	#6 Screw	2
5	FG3000-420-110	Chip Connector	1
6	FG3000-420-108	Chip Retainer	1
7	FG3000-270-100	Multiprocessor Chip	1
8	FG3000-370-103	Silver Zebra	2
9	FG3000-420-119	Cam	1
10	FG3000-450-110	Detent Spring	1
11	FG3000-410-114	LCD Retainer Kit, Series 300	1
12	FG3000-410-113	LCD Retainer Kit, Series 3000	1
13	FG3000-400-103	Fuse 600V/3A	1



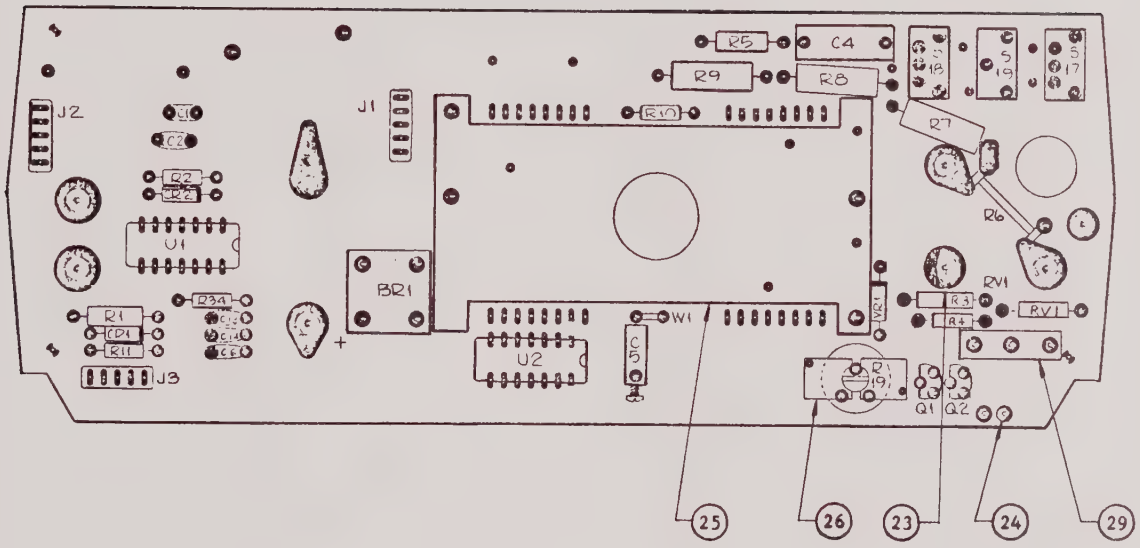
BENCH METERS - INPUT (LARGE) CIRCUIT BOARD

Index No.	Beckman Part No.	Description	Qty.
1	FG3000-370-145	Fuse Clip	2
2	FG3000-450-127	Washer #6	2
3	FG3000-360-100	Buzzer	1
4	FG3000-570-107	Assy, Input Wire	1
5	FG3000-450-122	Switch Assembly	1



BENCH METERS - INPUT (LARGE) CIRCUIT BOARD

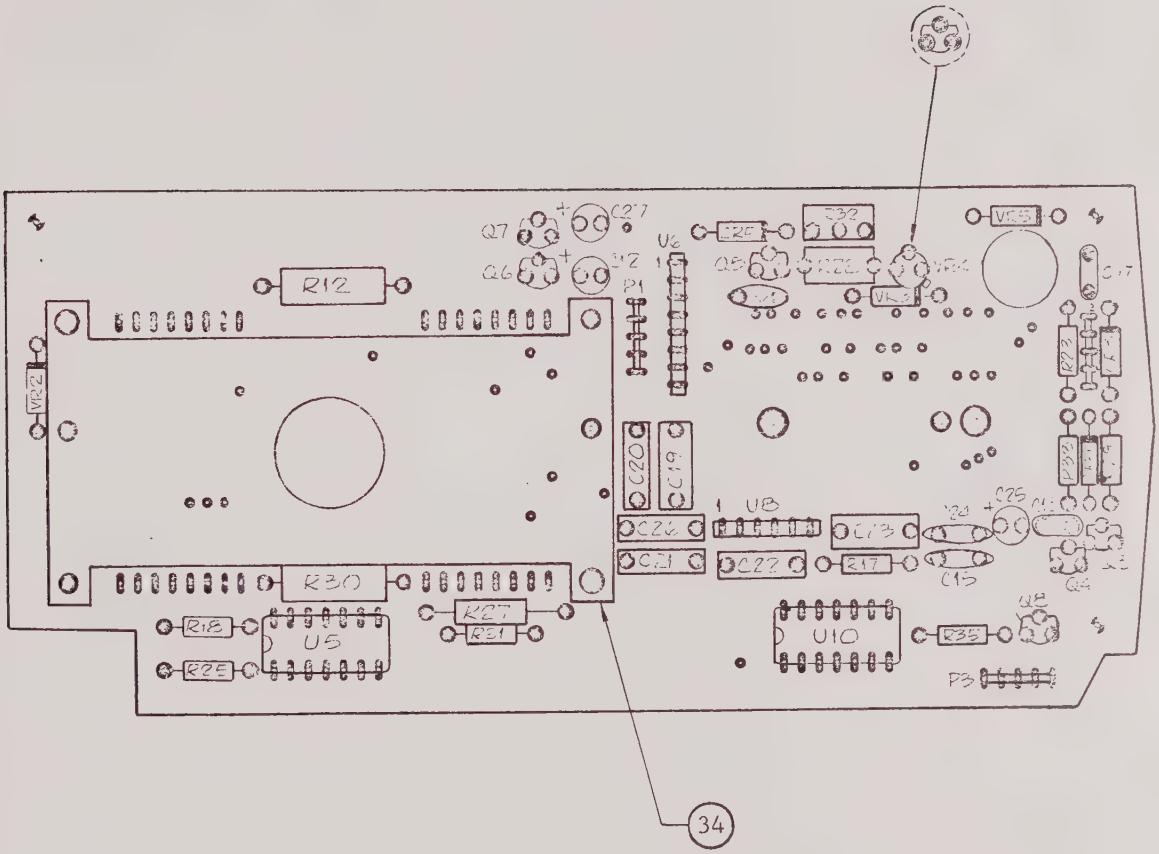
Index No.	Ref. Des.	Beckman Part No.	Description	Quantity Tech 350 Model 3050	Quantity Tech 360 Model 3060
1	BR1	FG3000-211-100	Bridge, 2 Amp	1	1
2	C2, 6, 13, 14	FG3000-101-104	Cap. .01 uF	3	4
3	C4	FG3000-130-104	Cap. .047 uF	1	1
4	C1	FG3000-111-100	Cap. .22 uF	1	1
5	CR1, 2	FG3000-201-100	Diode, Sm Sig	2	2
6	J1, 2, 3	FG3000-370-144	Conn Flex 5P	3	3
7	Q1, 2	FG3000-251-101	Tran NPN Gen	2	2
8	R4	FG3000-001-202	Res 2K	1	1
9	R2, 34	FG3000-001-105	Res 1M	2	1
10	R11	FG3000-001-165	Res 1.6M	1	1
11	R1, 5	FG3000-031-101	Res 100 Ohm	1	2
12	R3	FG3000-031-151	Res 150 Ohm	1	1
13	R6	FG3000-040-101	Shunt Res	1	1
14	R9	FG3000-051-106	Res 9 Ohm	1	1
15	R8	FG3000-071-101	Res .9 WW	1	1
16	R7	FG3000-071-104	Res .09 WW	1	1
17	R19	FG3000-090-108	Pot 5M	1	1
18	RV1	FG3000-081-102	Varistor 1720	1	1
19	U1	FG3000-270-104	IC CD4030	1	1
20	U2	FG3000-311-101	Atten Upper	1	1
21	VR1	FG3000-231-101	Diode Zener	1	1
22	W1	FG3000-370-109	Jumper	1	0
23	--	FG3000-373-141	Input Jack	3	3
24	--	FG3000-370-156	Conn Socket	2	2
25	--	FG3000-420-100	Switch Block	1	1
26	--	FG3000-420-127	Shaft Retain	1	1
27	C5	FG3000-191-100	Cap, Trimmer	0	1
28	R10	FG3000-001-474	Res 470K	0	1
29	--	FG3000-570-104	Assembly, TC	0	1



INPUT (LARGE) CIRCUIT BOARD
TECH 350, TECH 360
MODEL 3050, MODEL 3060

BENCH METERS - DISPLAY (SMALL) CIRCUIT BOARD

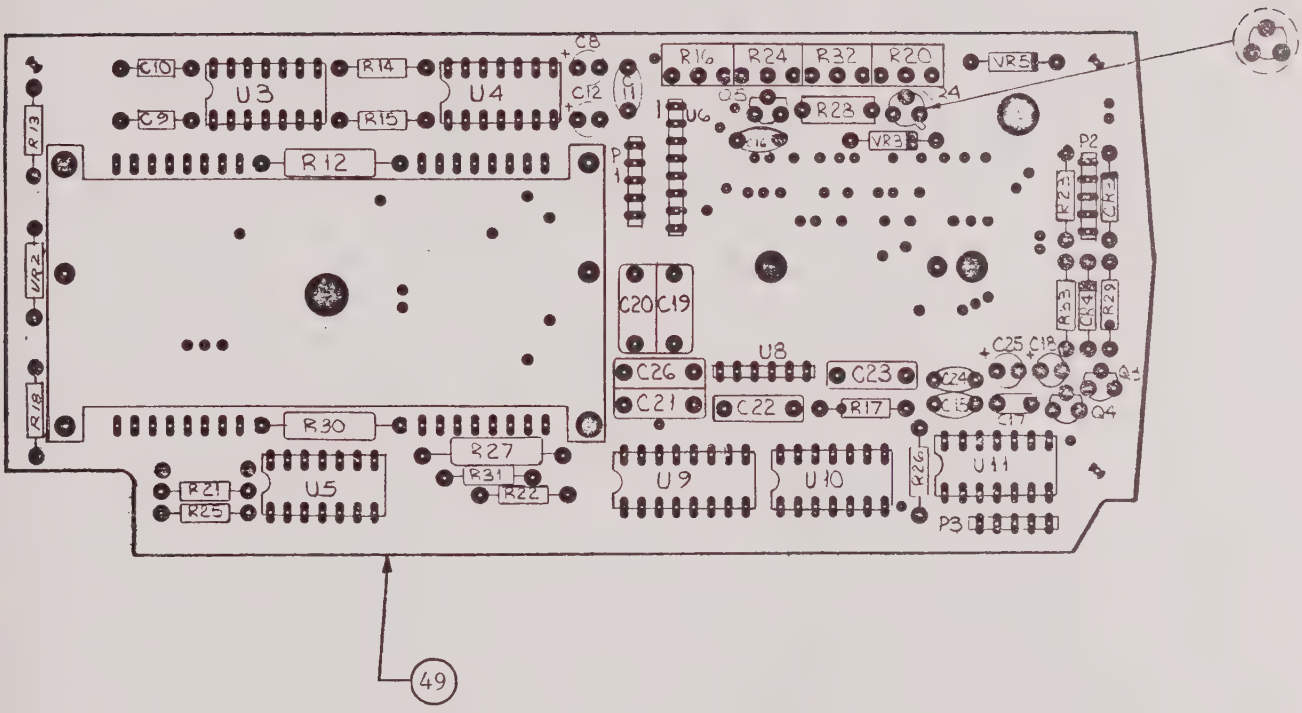
Index No.	Ref. Des.	Beckman Part No.	Description	Qty
1	C15	FG3000-101-101	Cap 33 pF	1
2	C24	FG3000-101-100	Cap 470 pF	1
3	C16	FG3000-101-104	Cap .01 uF	1
4	C26	FG3000-130-101	Cap .022 MYL	1
5	C20, 21, 22	FG3000-130-100	Cap .047 MYL	3
6	C19, 23	FG3000-130-102	Cap .22 MYL	2
7	C17, 18	FG3000-111-100	Cap .22 uF	2
8	C12	FG3000-151-100	Cap 3.3 uF TA	1
9	C27	FG3000-151-101	Cap 10 uF TA	1
10	C25	FG3000-161-100	Cap 10 uF	1
11	CR3, 4, 5	FG3000-201-100	Diode, Sm Signal	3
12	P1, 2, 3	FG3000-370-146	Cable Flex	3
13	Q6, 7, 8	FG3000-251-100	Tran PNP Gen	3
14	Q3, 5	FG3000-251-101	Tran NPN Gen	2
15	Q4	FG3000-251-102	Tran NPN DAR	1
16	R29	FG3000-001-121	Res 120 Ohm	1
17	R25	FG3000-001-103	Res 10K Ohm	1
18	R23	FG3000-001-104	Res 100K	1
19	R33	FG3000-001-474	Res 470K	1
20	R35	FG3000-001-914	Res 910K	1
21	R18, 31	FG3000-001-165	Res 1.6 M	2
22	R17	FG3000-001-516	Res 51 M	1
23	R27	FG3000-051-104	Res 22 Ohm	1
24	R12	FG3000-052-101	Res 200K	1
25	R30	FG3000-052-102	Res 2 M	1
26	R32	FG3000-090-105	Pot 10K	1
27	R28	FG3000-081-100	Res PTC	1
28	U8	FG3000-300-105	SIP 6-Pin	1
29	U6	FG3000-300-106	SIP 8-Pin	1
30	U5	FG3000-310-100	Ref Divider	1
31	U10	FG3000-270-103	IC CD4007	1
32	VR2, 3, 5	FG3000-231-103	Zener Diode	3
33	VR4	FG3000-231-102	Diode Ref	1
34	--	FG3000-420-100	Switch Block	1



DISPLAY BOARD

TECH 350, MODEL 3050

Index No.	Ref. Des.	Beckman Part No.	Description	Qty
1	C15	FG3000-101-101	Cap 33 pF	1
2	C24	FG3000-101-100	Cap 470 pF	1
3	C16	FG3000-101-104	Cap .01 uF	1
4	C26	FG3000-130-101	Cap .022 MYL	1
5	C20, 21, 22	FG3000-130-100	Cap .047 MYL	3
6	C19, 23	FG3000-130-102	Cap .22 MYL	2
7	C17, 18	FG3000-111-100	Cap .22 uF	2
8	C12	FG3000-151-100	Cap 3.3 uF TA	1
9	C27	FG3000-151-101	Cap 10 uF TA	1
10	C25	FG3000-161-100	Cap 10 uF	1
11	CR3, 4, 5	FG3000-201-100	Diode, Sm Signal	3
12	P1, 2, 3	FG3000-370-146	Cable Flex	3
13	Q6, 7, 8	FG3000-251-100	Tran PNP Gen	3
14	Q3, 5	FG3000-251-101	Tran NPN Gen	2
15	Q4	FG3000-251-102	Tran NPN DAR	1
16	R29	FG3000-001-121	Res 120 Ohm	1
17	R25	FG3000-001-103	Res 10K Ohm	1
18	R23	FG3000-001-104	Res 100K	1
19	R33	FG3000-001-474	Res 470K	1
20	R35	FG3000-001-914	Res 910K	1
21	R18, 31	FG3000-001-165	Res 1.6 M	2
22	R17	FG3000-002-516	Res 51 M	1
23	R27	FG3000-051-104	Res 22 Ohm	1
24	R12	FG3000-052-101	Res 200K	1
25	R30	FG3000-052-102	Res 2 M	1
26	R32	FG3000-090-105	Pot 10K	1
27	R28	FG3000-081-100	Res PTC	1
28	U8	FG3000-300-105	SIP 6-pin	1
29	U6	FG3000-300-106	STP 8-pin	1
30	U5	FG3000-310-100	Ref Divider	1
31	U10	FG3000-270-103	IC CD4007	1
32	VR2, 3, 5	FG3000-231-103	Zener Diode	3
33	VR4	FG3000-231-102	Diode Ref	1
34	--	FG3000-420-100	Switch Block	1
35		FG3000-111-102	Cap 33 pF	1
36	C10	FG3000-111-103	Cap 220 pF	1
37	C8	FG3000-151-102	Cap 47 uF TAN	1
38	R21	FG3000-051-107	Res 12 Ohm	1
39	R15	FG3000-001-120	Res 12 Ohm	1
40	R14	FG3000-001-201	Res 200 Ohm	1
41	R24	FG3000-090-107	Pot 500	1
42	R20	FG3000-090-109	Pot 2M	1
43	R16	FG3000-090-106	Pot 5M	1
44	U5	FG3000-310-105	DIP	1
45	U4	FG3000-310-104	DIP	1
46	U3	FG3000-270-101	RMS Converter	1
47	U9	FG3000-270-105	IC CD4053	1

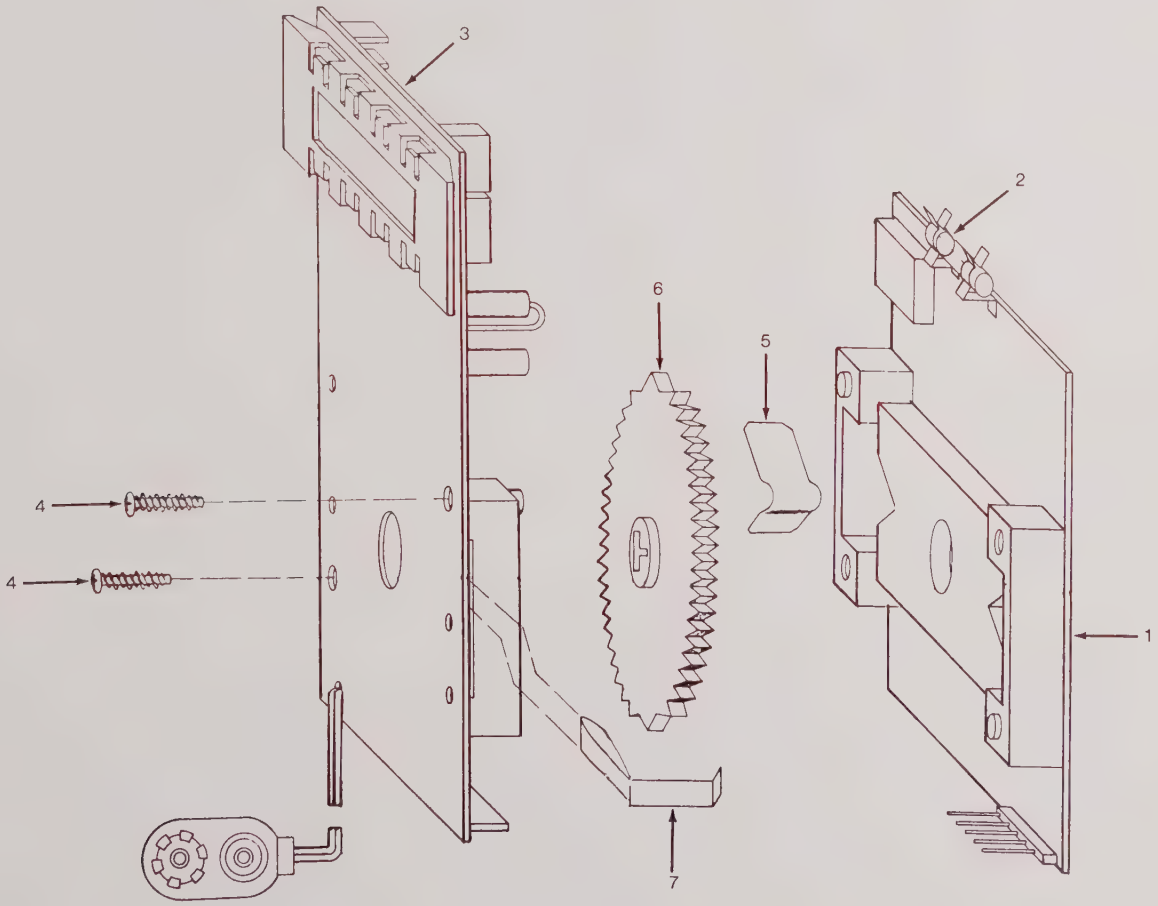


DISPLAY BOARD

Tech 360, Model 3060

HD100
ELECTRONICS ASSEMBLY

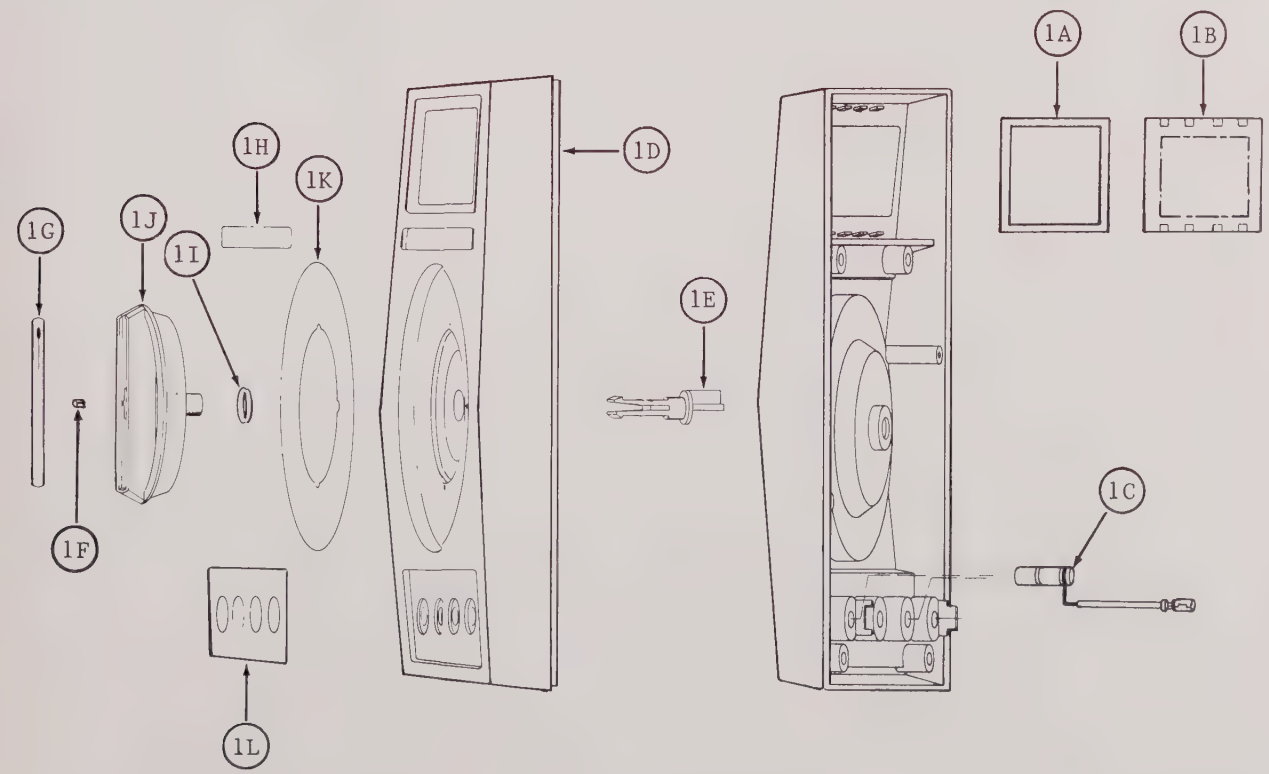
Index No.	Ref Des	Beckman Part No.	Description	Qty. Per Assembly
1	F1	FG3000-400-101	Fuse, 2-Ampere	1
2		FG3000-450-102	Screw, No. 6, Thread Forming, 3/4-inch	2
3		FG3000-450-110	Spring Detent	1
4		FG3000-420-101	Cam, Function/Range Switch	1
5		FG3000-370-115	Spring Contact, DSN Aquadag	1



Parts indexed with a letter are available only as part of the main assembly kit.

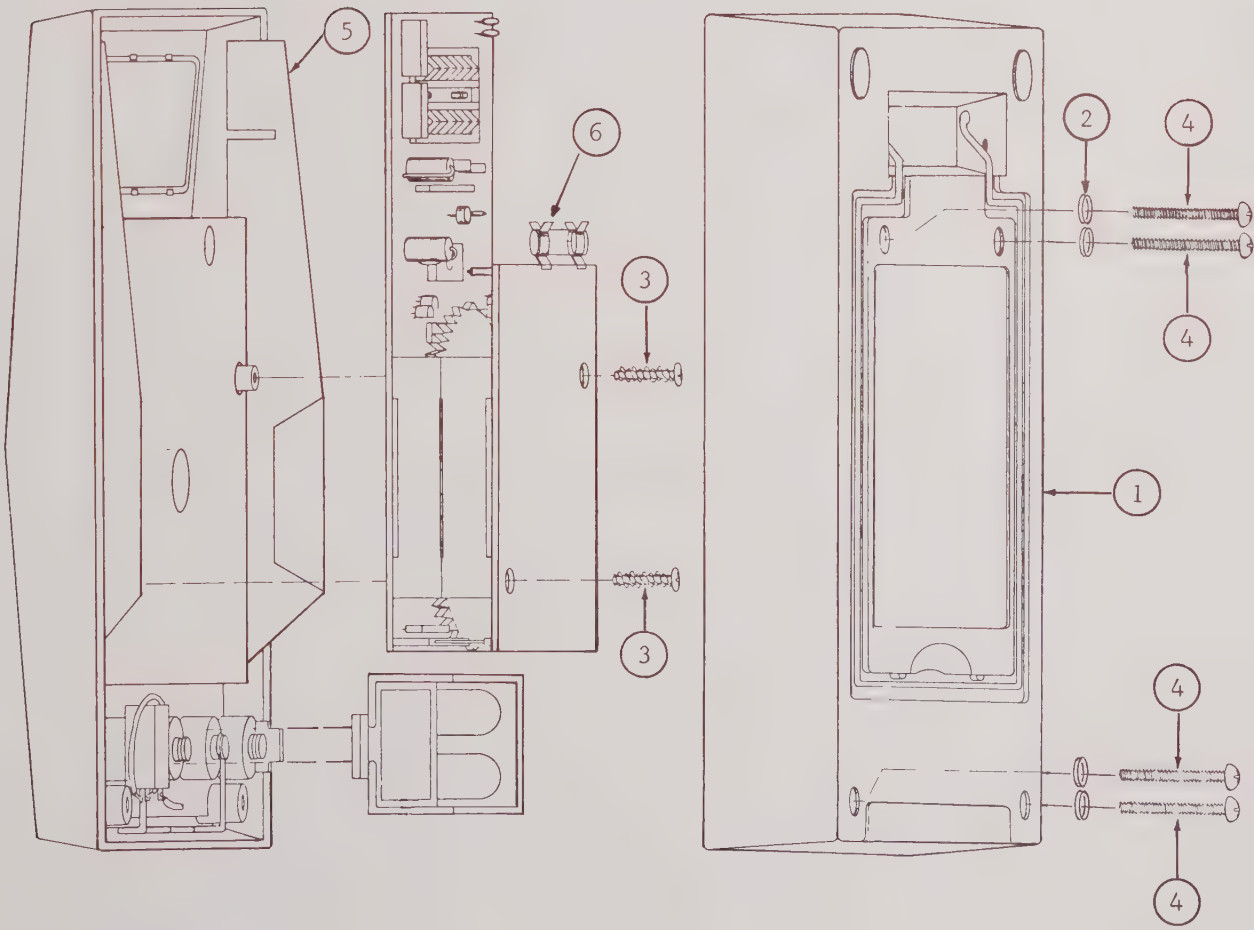
HD100 - FRONT HOUSING ASSEMBLY

Index No.	Beckman Part No.	Description	Qty.
1	FG3000-420-172	HD100 Case Top Kit	
1A	FG3000-450-154	Window Seal	1
1B	FG3000-420-106	Window	1
1C	FG3000-543-022	Input Jack	3
1D	FG3000-421-175	Top Case, HD100	1
1E	FG3000-420-102	Shaft	1
1F	FG3000-420-152	Shaft Retainer	1
1G	FG3000-920-399	Knob Overlay	1
1H	FG3000-920-299	HD100 Logo	1
1I	FG3000-450-105	O-Ring Seal	1
1J	FG3000-420-151	Knob, HD100	1
1K	FG3000-920-107	Switch Overlay, HD100	1
1L	FG3000-920-200	Jack Overlay, HD100	1



HD100 MULTIMETER ASSEMBLY

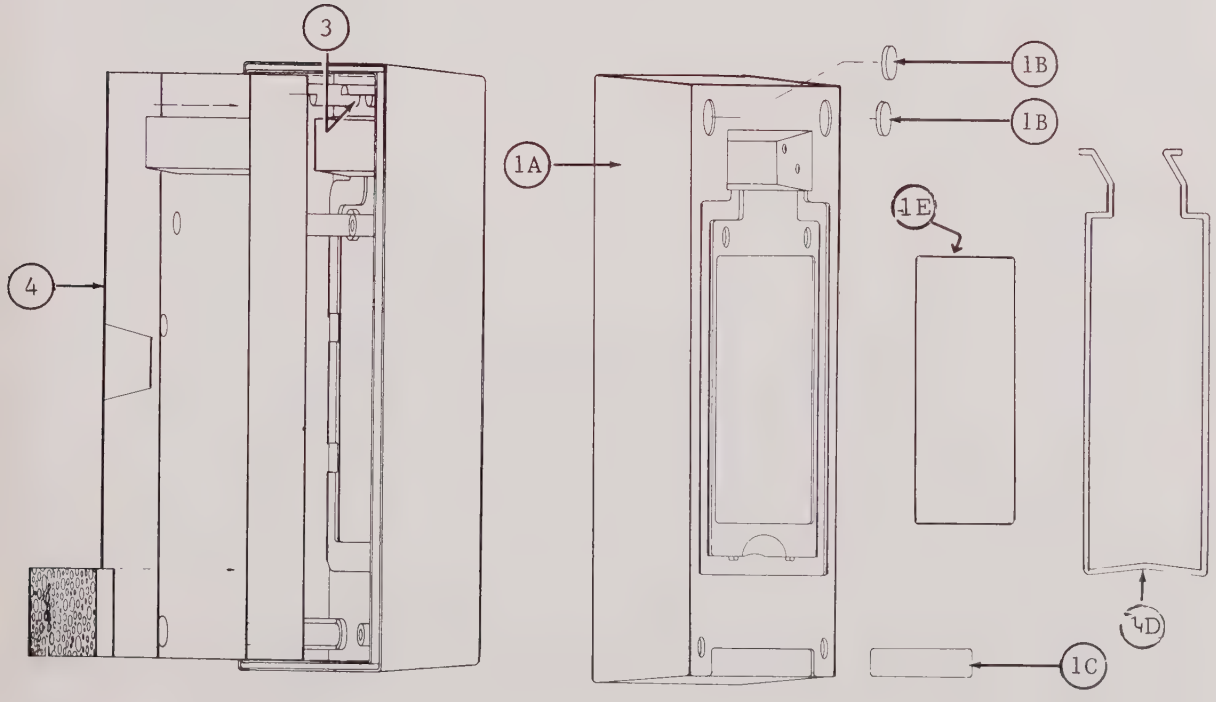
Index No.	Beckman Part No.	Description	Qty.
1	FG3000-450-151	O-Ring Seal	1
2	FG3000-450-152	Screw O-Ring	4
3	FG3000-450-104	No. 4 Screw	2
4	FG3000-450-103	4-40 Screw	4
5	FG3000-450-116	Shield, Upper	1
6	FG3000-450-105	O-Ring	2



Parts indexed with a letter are available only as part of the main assembly kit.

HD100 - REAR HOUSING ASSEMBLY

Index No.	Beckman Part No.	Description	Qty.
1	FG3000-420-173	HD100 Rear Case Kit	
1A	FG3000-420-174	Bottom Case	1
1B	FG3000-450-107	Rubber Foot	2
1C	FG3000-450-108	Rubber Pad	1
1D	FG3000-451-100	Bail, Coated	1
1E	FG3000-920-499	Overlay Instructions	1
3	FG3000-400-101	Fuse, 2A	1
4	FG3000-570-119	Lower Shield	1

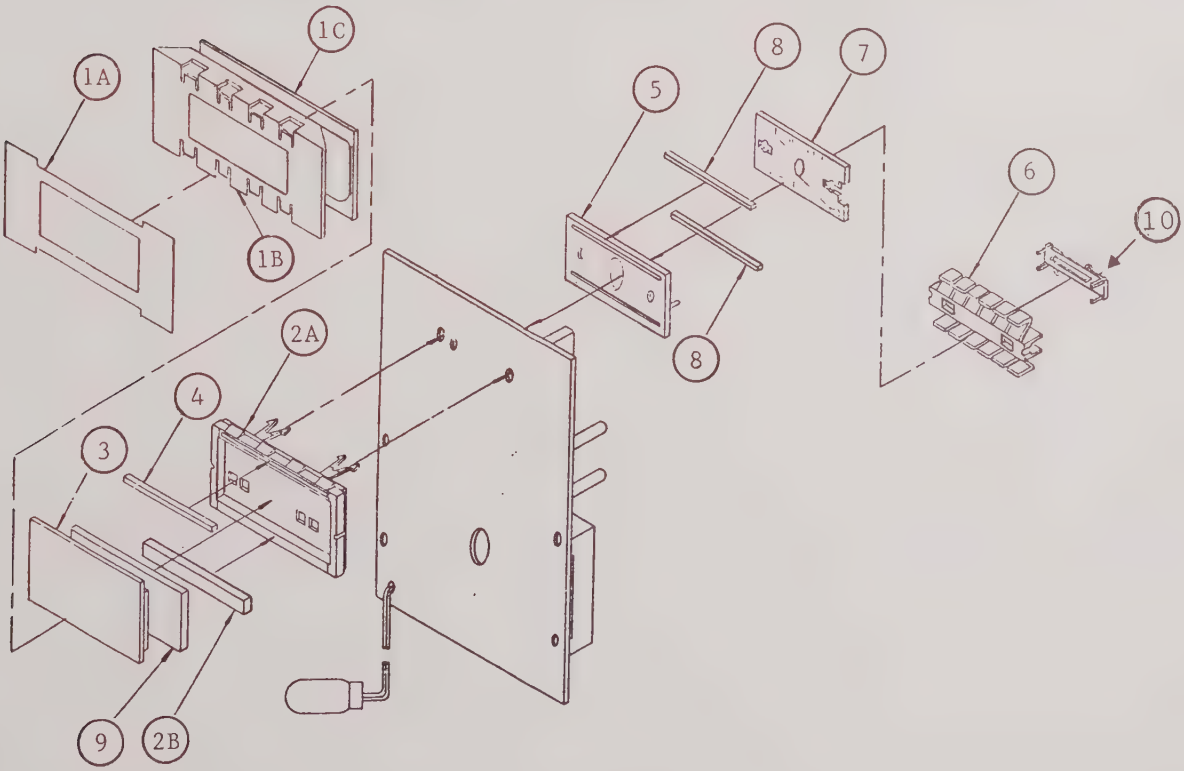


Front View

Parts indexed with a letter are available only as part of the main assembly kit.

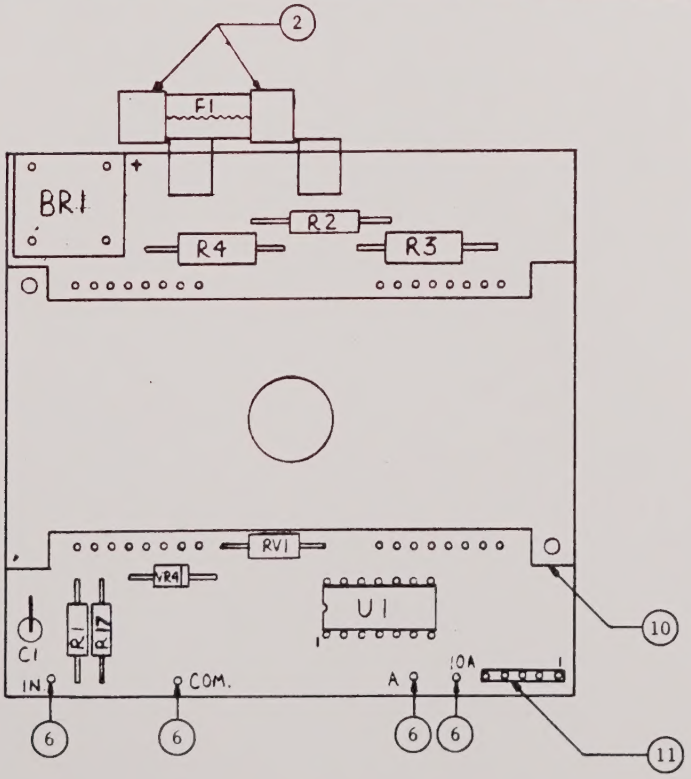
HD100 - ELECTRONICS ASSEMBLY

Index No.	Beckman Part No.	Description	Qty.
1	FG3000-560-100	HD100 LCD Retainer Kit	
1A	FG3000-920-599	Window Mask	1
1B	FG3000-420-107	LCD Retainer	1
1C	FG3000-370-173	Shock Mount	1
2	FG3000-560-101	HD100 Connector Kit	
2A	FG3000-421-111	LCD Connector	1
2B	FG3000-371-173	Shock Mount	1
3	FG3000-390-101	LC Display	1
4	FG3000-370-102	Carbon Zebra	1
5	FG3000-420-110	Chip Connector	1
6	FG3000-420-108	Chip Retainer	1
7	FG3000-270-100	Multiprocessor Chip	1
8	FG3000-370-103	Silver Zebra	2
9	FG3000-960-112	Shock Absorber	1
10	FG3000-421-141	Retainer Mount	1



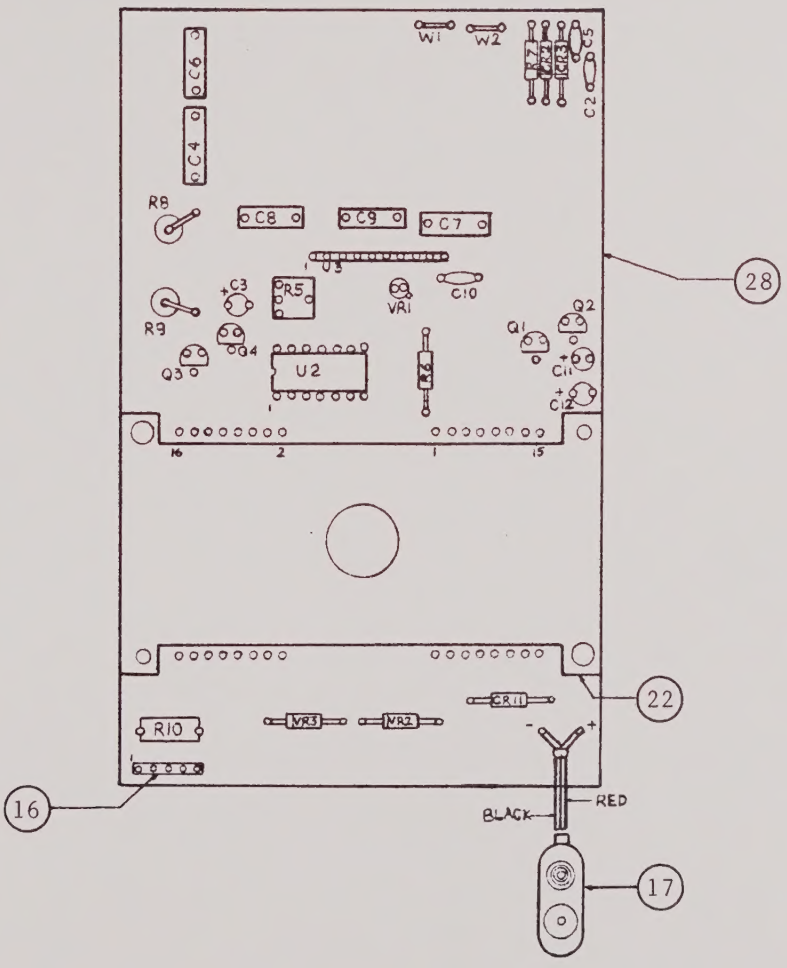
HD100 - SMALL CIRCUIT BOARD

Ref. Des.	Index No.	Beckman Part No.	Description	Qty
U1	1	FG3000-310-101	Attenuator	1
	2	FG3000-370-107	Fuse Clip	2
BR1	3	FG3000-211-100	Bridge	1
C1	4	FG3000-131-205	Cap. .047	1
R1	5	FG3000-031-202	Res. 2K ½W	1
	6	FG3000-370-110	Terminal Pin	4
R2	7	FG3000-051-106	Res WW 9 Ohms	1
R3	8	FG3000-071-101	Res WW .9 Ohm	1
R4	9	FG3000-071-100	Res WW .1 Ohm	1
	10	FG3000-420-100	Switch Block	1
	11	FG3000-370-100	M Conn. 5 pin	1
F1	12	FG3000-400-101	Fuse, 2A	1
RV1	13	FG3000-081-102	MOV	1
VR4	14	FG3000-231-101	Zener Diode	1
R17	15	FG3000-011-241	Res 240 ¼W	1



HD100 - LARGE (DISPLAY) CIRCUIT BOARD

Index No.	Ref. Des.	Beckman Part No.	Description	Qty
1	C8, 9	FG3000-130-102	Cap .22 MFD	2
2	C6	FG3000-130-101	Cap .022 MFD	1
3	C4, 7	FG3000-130-100	Cap .047 MFD	2
4	C3	FG3000-151-101	Cap 10UF Tan	1
5	C11	FG3000-161-100	Cap 10 elyt	1
6	C2, 5	FG3000-111-100	Cap .22UF	2
7	C12	FG3000-151-100	Cap 3.3 UF	1
8	C10	FG3000-101-100	Cap 470 PF	1
9	R8	FG3000-051-102	Res 2M	1
10	R9	FG3000-051-101	Res 200K	1
11	R10	FG3000-081-103	Res PTC	1
12	Q3, 4	FG3000-251-100	Tran PNP Gen	2
13	Q1	FG3000-251-101	Tran NPN Gen	1
14	Q2	FG3000-251-102	Tran NPN Dar	1
15	VR2, 3	FG3000-231-101	Zener Diode	2
16		FG3000-370-101	F Conn 5 Pin	1
17		FG3000-371-105	Battery Snap	1
18	CR1, 2, 3	FG3000-201-100	Diode Sm Sig	3
19	VR1	FG3000-231-102	Diode Ref	1
20	R6	FG3000-001-241	Res 240 Ohm	1
21		FG3000-420-100	Switch Block	1
22	U3	FG3000-300-100	SIP 10 Pin	1
23	R5	FG3000-090-101	Pot 10K	1
24	U2	FG3000-310-100	Ref Divider	1
25	R7	FG3000-001-474	Res 470K	1
26		FG3000-450-119	Cable Tie	1



DISPLAY (LARGE) BOARD
FOR HD 100

Beckman Instruments, Inc., Fullerton, CA 92634
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BECKMAN

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